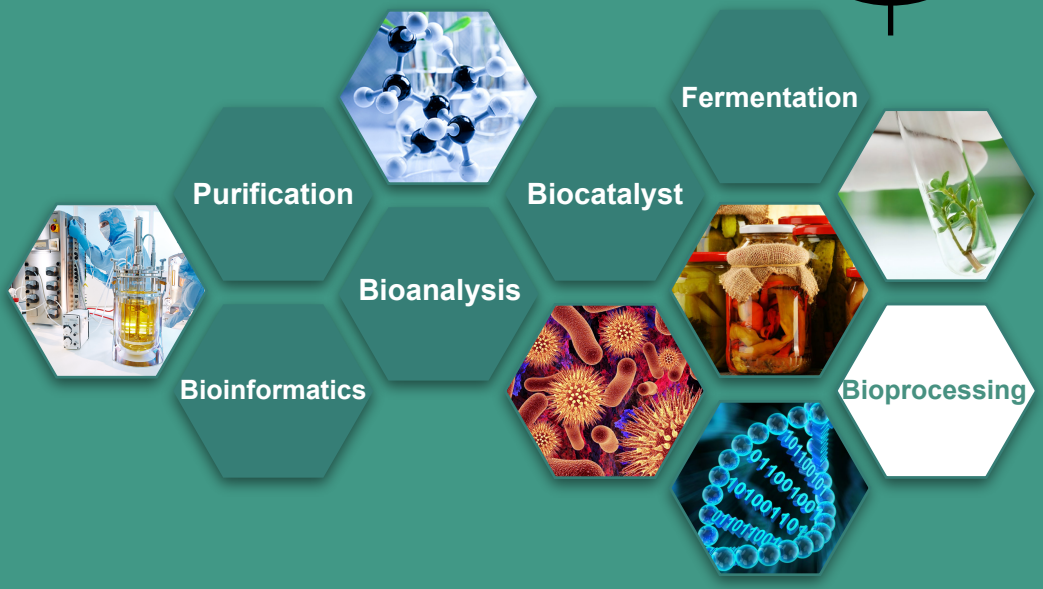
UNIVERSITI SAINS MALAYSIA

PUSAT PENGAJIAN TEKNOLOGI INDUSTRI

Bachelor of Bioprocess Engineering Technology with Honours

ACADEMIC HANDBOOK

22/23



School of Industrial Technology
Universiti Sains Malaysia
www.indtech.usm.my

Academic Handbook
Bachelor of Bioprocess Engineering Technology with Honours
Academic Calendar 2022/2023

A full version of the Academic Handbook can be access from USM Division of Academic & International website (http://baa.usm.my) or via the QR code provided. The Academic Handbook is for staff and student in USM only. A valid USM Campus Online username and password are required to access the Academic Handbook.

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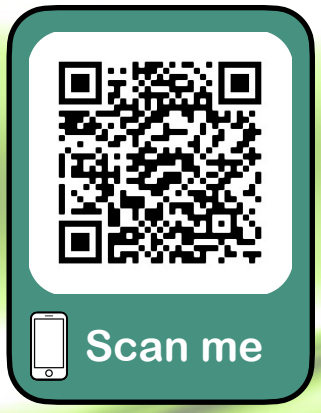

Full version of the Academic Handbook

Vision and Mission

Universiti Sains Malaysia

Vision

Transforming Higher Education for a Sustainable Tomorrow

Mission

USM is a pioneering, transdisciplinary research intensive university that empowers future talents and enables the bottom billions to transform their socio-economic well-being

Vision and Mission

School of Industrial Technology

Vision

World class centre in technological innovation for a sustainable tomorrow

Mission

1. To be the prime education provider of technologists who are competent, capable of independent thinking, possess communication and analytical skills, and able to fulfil the needs in various industries and socio-economic development.

2. To pursue cutting-edge research in the fields of Food Technology, Bioresource Technology, Environmental Technology, and Bioprocess Engineering Technology.

3. To contribute to the well-being of the community through sustainability-led dynamic transdisciplinary academic programmes, research innovation, teamwork, and continuous improvement.

Niche Research Area

School of Industrial Technology

Sustainable Materials, Processing, and Energy Technologies

History

School of Industrial Technology

1973

The School of Industrial Technology commenced with the establishment of the School of Applied Sciences. The School offered the Bachelor of Applied Science programmes in Electronic Science and Technology, Food Science and Technology, and Polymer Science and Technology.

1984

The name of the School was changed to the School of Engineering Sciences and Industrial Technology. Hence, the curricula were amended to Bachelor of Engineering (B. Eng) and Bachelor of Technology (B. Tech) to meet the requirement of engineering and industrial technology courses.

1986

The School was split into :
- School of Electrical and Electronic Engineering
- School of Materials and Mineral Resources Engineering
- School of Industrial Technology

School of Industrial Technology offered Bachelor of Technology programmes in Food Technology, Polymer Science and Technology, Quality Control & Instrumentation, and Wood, Paper and Coatings Technology.

2001

Polymer Technology and Quality Control & Instrumentation programmes were upgraded into:
- Polymer Engineering programme
- Mechatronic Engineering programme

1999

Environmental Technology programme was introduced by School of Industrial Technology.

2002

Wood, Paper and Coatings Technology programme was renamed Bioresource, Paper and Coatings Technology programme.

2008

Bioprocess Technology programme was introduced by School of Industrial Technology.

2018

Master of Science (Environmental Science) programme was introduced by School of Industrial Technology.

2020

Bioresource, Paper and Coatings Technology programme was renamed Bioresource Technology programme.

2022

Bioprocess Technology programme was changed to Bioprocess Engineering Technology programme.

Management

School of Industrial Technology

1	Dean	Prof. Datuk Ts. Dr. Abdul Khalil Shawkataly, D.S.P.N., D.P.S.M.
2	Deputy Dean (Academic, Career & International)	Assoc. Prof. Dr. Mardiana Idayu Ahmad
3	Deputy Dean (Research, Innovation & Industrial - Community Engagement)	Assoc. Prof. Dr. Husnul Azan Tajarudin
4	Deputy Dean (Resource Development & Branding)	Assoc. Prof. Dr. Leh Cheu Peng
5	Programme Chairman (Food Technology)	Assoc. Prof. Dr. Uthumporn Ultra @ Sapina Abdullah
6	Programme Chairman (Environmental Technology)	Assoc. Prof. Dr. Yusri Yusup
7	Programme Chairman (Bioresource Technology)	Ts. Dr. Nurul Fazita Mohammad Raw
8	Programme Chairman (Bioprocess Engineering Technology)	Dr. Mohamad Hafizi Abu Bakar
9	Senior Assistant Registrar (Academic & Administration)	Mdm. Rasslene Rass Rasalingam
10	Assistant Registrar (Postgraduate & Human Resource)	Ms. Nur 'Aqila Badrul Hisham

Academic Programme

The School of Industrial Technology offers the following bachelor degrees:

- Bachelor of Technology (Honours) (Food)
- Bachelor of Technology (Honours) (Bioresource)
- Bachelor of Technology (Honours) (Environment)
- Bachelor of Bioprocess Engineering Technology with Honours

Acceptance to any of the above programmes is subjected to selection and entry qualification. Most of the first year courses consist of basic science courses in Chemistry, Mathematics, Physics, and Computer. From level 200, all students are required to enrol for courses relevant to their respective programmes up to level 300 (Bioresource and Environmental Technologies) or 400 (Food and Bioprocess Engineering Technologies), whereby they are required to conduct one final year research project.

Students are also required to undergo industrial training in various industries relevant to their study programme for 12 (Food, Bioresource, and Environment Technologies) or 24 (Bioprocess Engineering Technology) weeks. This training is aimed at exposing the students to actual working practice and atmosphere of the industry.

Bioprocess Engineering Technology

Bioprocess Engineering Technology (a four-year program) is the sub-discipline within Biotechnology and Chemical Engineering that combines living matter, in the form of organisms or enzymes, with nutrients under specific optimal conditions to make the desired product. The discipline is responsible for translating discoveries of life sciences into practical and industrial products processes and techniques that can serve the need of the society. The stages involved in Bioprocess Engineering Technology includes the preparation stage vis-à-vis the raw materials, substrates and media, the conversion state, biocatalysts, downstream processing, volume production, purification and final product processing. Graduates from this programme will also have the knowledge and skill to understand the fundamental bioprocess research and relate it to the industrial scale. This program is provisionally accredited by Board of Engineer Malaysia (BEM).

The Bioprocess Engineering Technology curriculum is spread over four (4) years of studies, with great emphasis placed on the logical sequence of related courses and at the same time, ensuring that the teaching-learning activities are equally distributed throughout the study period.

Programme Educational Goal & Objectives

The goal of the Bachelor of Bioprocess Engineering Technology with Honours degree programme is to produce graduates who have specialised expertise, solid knowledge, critical thinking, creative, research skills in the field of Bioprocess Engineering Technology to meet the employable needs of the country in various related industries or agencies and graduates and able to lead the community for sustainable national development.

Therefore, the Bachelor of Bioprocess Engineering Technology with Honours degree programme is designed to produce graduates:

- are competent, creative, innovative and capable of solving problems related to Bioprocess Engineering Technology at the global and society levels at the context of sustainable development.
- have high leadership qualities and communication skills in addition to active involvement in engineering technology processes independently and in teams of different disciplines.
- graduates with professional and ethical qualities.
- constantly strive to acquire new knowledge through research, continuing education and/or professional development activities.

Mentor-Mentee System & Counselling Service

The mentors are appointed among the academic staff of the school who provide assistance and guidance to students, mainly in academic matters. However, the school has established an open mentor system, whereby probation students are free to see any of the mentors. Nevertheless, probation students are recommended to discuss academic- related problems with mentors from their own programme.

The mentors appointed are as listed below:

No.	Name	Room No.	Phone Extension	E-mail Address
1.	Dr. Siti Baidurah Yusoff	A301	6381	sitibaidurah@usm.my
2.	Mdm. Wan Zafira Ezza Wan Zakaria	A303	6362	ezzafira@usm.my

Programme Learning Outcomes

At the end of the programme, students will be able to:

1. Apply knowledge related to mathematics, science and fundamentals of bioprocess engineering to defined and applied bioprocess engineering technology procedures, processes, systems or methodologies (Knowledge).
2. Identify, formulate, research literature reviews and analyse broadly defined engineering related problems reaching proven conclusions using analytical tools appropriate to Bioprocess Engineering Technology (Problem Analysis).
3. Design solutions to problems related to Bioprocess Engineering Technology to meet the specific needs of public health and safety, culture, society and environment (Design/Development of Solutions).
4. Investigate problems using appropriate research knowledge and methods (Investigation).
5. Produce, select and apply the use of modern technological equipment that is appropriate and essential for Bioprocess Engineering Technology activities based on an understanding of the limits of the activity (Modern Tool Usage).
6. Apply reasoning based on contextual knowledge to assess issues related to society, health, safety, law and culture and responsibilities related to the professional practice of Bioprocess Engineering Technology (The Engineer and Society).
7. Professionally assess the impact of solutions by Bioprocess Engineering Technology on society, environmental contexts and sustainability development (Environment and Sustainability).
8. Apply principles ethically and committed to professional ethics and the responsibilities and norms of Bioprocess Engineering Technology practice (Ethics).
9. Function effectively as an individual, and as a member or leader in a diverse and multidisciplinary team (Individual and Teamwork).
10. Communicate effectively on Bioprocess Engineering Technology activities with the community of engineering technologists and society at large (Communications).
11. Demonstrate knowledge and understanding related to engineering and management principles while being able to apply these criteria to tasks, as a member and leader in a team, to manage projects and in environments involving various disciplines (Project Management and Finance).
12. Recognise needs and have the preparation and ability to engage in the lifelong learning process independently as technology shifts to a broader context (Life Long Learning).

Programme Requirements

Course Code Classification	Normal Programme	Min. Total Unit Requirements
T	100	140
E	20	
U	20	

Notes:
T (core courses) – compulsory courses for a particular area of specialisation that must be taken and passed.
E (elective courses) – courses must be taken by students with elective programme to strengthen their technology specialisation courses.
U (university requirements) – courses to fulfil the university requirements.

Details of Programme

Type of Programme	Structure of Programme
Bachelor of Bioprocess Engineering Technology with Elective	Students choose several elective courses to widen their specialisation area and their knowledge in industrial technology.

Graduation Requirements

- ☑ Fulfil the minimum required (8 semesters) of the residential requirement for the programme of study and has not exceeded the maximum period of study (14 semesters).
- ☑ Fulfil all credit requirements of the courses for the programme of study required units such as the requirements for each component (core, elective, and university courses or option).
- ☑ Obtained a CGPA of 2.00 and above for core courses.
- ☑ Obtained a CGPA of 2.00 and above for the programme.
- ☑ Achieved a minimum of 'C' or a grade point of 2.00 for Bahasa Malaysia, English (4 units), Appreciation of Ethics and Civilisations, Philosophy and Current Issues, and Core Entrepreneurship courses.

University Requirements for Graduation

LOCAL STUDENTS	
Compulsory Courses	**Units**
❖ LKM400/2 Bahasa Malaysia IV	2
English Language **(MUET Band 6)** ❖ (LHP451/452/453/454/455/456/457/458/459) **and/or** ❖ Foreign language courses English Language **(MUET Band 5)** ❖ LSP402/2 Scientific and Medical English **and** ❖ LHP451/452/453/454/455/456/457/458/459 English Language **(MUET Band 4)** ❖ LSP300/2 Academic English English Language **(MUET Band 2 – 3)** ❖ LMT100/2 Preparatory English*** or** ❖ Re-sit MUET ** Prerequisite for LSP300/2 Academic English*	4
❖ HFE224/2 Appreciation of Ethics and Civilisations	2
❖ HFF225/2 Philosophy and Current Issues	2
❖ WUS101/2 Core Entrepreneurship	2
❖ Co-curricular	2
Optional Courses	**Units**
❖ Co-curricular/Skills Courses/Foreign Language Courses/Options ❖ WSU101/2 Sustainability: Issues, Challenges & Prospect	6
Minimum Requirements	**20**

INTERNATIONAL STUDENTS	
Compulsory Courses	**Units**
❖ LKM100/2 Bahasa Malaysia I	2
❖ English Language courses	4
** Students may obtain advice from the School of Languages, Literacies and Translation if they have different English Language Qualification.*	
❖ SEA205E/4 Malaysian Studies	4
❖ Option/Bahasa Malaysia/English Language	2
❖ Co-curricular	2
Optional Courses	**Units**
❖ Co-curricular/Skills Courses/Foreign Language Courses/Options ❖ WSU101/2 Sustainability: Issues, Challenges & Prospect	6
Minimum Requirements	**20**

***Student must pass all University courses with the minimum grade of C.**

Curriculum Structure

COURSE TYPE	LEVEL 100 (2022/2023)				LEVEL 200 (2023/2024)				LEVEL 300 (2024/2025)				LEVEL 400 (2025/2026)				TOTAL UNIT
	SEMESTER 1		SEMESTER 2		SEMESTER 1		SEMESTER 2		SEMESTER 1		SEMESTER 2		SEMESTER 1		SEMESTER 2		
CORE (T)	IBK104/3 IEK101/3 IMK227/3 IUK108/4 IUK191/4	SEMESTER BREAK	IBA104/3 IBG112/3 IBG111/3 IBG205/3 IEK108/3 IUK291/4	SESSION BREAK	IBG211/3 IBG214/4 IEA216/3 IEK212/3	SEMESTER BREAK	IBG207/3 IBG215/4 IEK213/3	SESSION BREAK	IBA312/3 IBA319/4 IBG307/3 IBK314/3	SEMESTER BREAK	IBA306/8** IBG319/4	SESSION BREAK	IBA306/8** IBA407/4	SEMESTER BREAK	IBA406/12*		100
	17		19		13		10		13		8		8		12		
ELECTIVE (E)					IBK212/2 IBK215/2 IBK218/2 IMK221/3		IEA112/4 IEK115/3 IMK113/3 IUK208/3		IBK315/2 IBK316/3 IBK317/3 IBK412/3		IBK318/3 IEK219/3 IMK326/3 IUK303/3		IBK411/3 IBK413/3 IMK316/3				20
					2–3		3–7		3		6		3–6				
UNIVERSITY (U)	WUS101/2 LKM400/2 Ko-K/1-2		WSU101/2 Ko-K/1-2		HFF225/2		LMT100/2 or LSP300/2 HFE224/2		LSP300/2 or LSP402/2 HTV201/2		LSP402/2						20
	5–6		2–4		2		4		4		2						
TOTAL MINIMUM CREDIT FOR GRADUATION																	140

*** Students must register for this course online during their internship.**
**** Course is offered in TWO (2) semesters (unit counted per semester is 4).**

List and Synopsis of Courses

Level 100

1. IBA104/3 Practical for Technologists

This course emphasizes on the various biological cells and fundamental techniques in cell biology. Practical components include various fundamental techniques such as microscopy, microbial growth medium, culturing techniques, staining and differentiation of cells, antimicrobial activities and DNA extraction from cells.

2. IBG111/3 Industrial Microbiology

This course discusses the involvement of microorganisms in industrial processes, specifically in the production of various product materials including enzymes, food beverages, fuels, pharmaceutics, organic solvents, cell biomass and also clean technology that is used for waste treatment and pollution control. Emphasis will be given on the determination of important industrial microorganism, selection and isolation methods, maintenance, storage, improvement of industrial microorganism and the involvement of microorganisms in various industries. Relevant practical classes will also be conducted .

3. IBG112/3 Bioanalysis I

This course covers the principals and analytical methods (quantitative and qualitative) to analyze bioprocess product, such as carbohydrates, protein, amino acids, and lipids. Laboratory practice related to the topic are conducted.

4. IBK104/3 Fundamentals of Bioprocess Technology

This course encompasses the definition of Bioprocess Technology, discussions of similarities and differences with the disciplines of Bioprocess Engineering and Biotechnology. The course also describes the existence of disciplines of Bioprocess Technology, a string of history of penicillin discovery, bioprocessing advantages over chemical processing, various bioprocessing products and basic knowledge as bioprocess technologists (cell diversity as catalyst agent, cell growth requirements, cell composition, enzymes and metabolic pathways). The diversification of cell growth reactors, monitoring and measurement of kinetic growth, multiple stages of processing of bioprocess product, Bioprocess Technology application in the treatment of animal and plant cell waste and culture. Students are also exposed to research areas in Bioprocess Technology.

5. IEA112/4 Society and Environment Project

This course introduces students to the community and the environment through the interdisciplinary discipline of natural sciences with socio-political sciences and links environmental-ecological, social and economic aspects toward achieving sustainable societies. Students will be exposed to the concept of capitalism encompassing the world's economic-political system in line with the environmental-ecological crisis. Students will be encouraged to discuss and articulate their views on the interests of various conflicting parties, for example between government, corporate and non-governmental environmental activists. Students will also propose and implement appropriate, individual and group social projects on the exploitation of natural resources and waste generation by the industrial community.

6. IEK101/3 Chemical Process Calculations

This course is about general calculations involved in chemical processes. The students will be exposed to mass and energy balance and the steps needed to solve related problems. These topics will help the students solve problems effectively through the correct problem-solving methodology, relevant data collection and data analysis. This course also introduces the student to the properties and phase behaviour of steam, gases as well as basics of chemistry and physics.

7. IEK108/3 Process Fluid Mechanics

Course Prerequisites: s IEK101/3

This course introduces students to the concept of fluid statics, incompressible and compressible fluid flow as well as flow across submerged bodies. Students will also be exposed to the topics of metering, separation, mixing and pumping. Other topics include Fanning friction factor, pumping power and cost, as well as flow rate calculations.

8. IEK115/3 Environment, Safety and Health Legislation

This course exposes the student to the concept of environmental, occupational safety and health management based on two main acts, Environmental Quality Act 1974 and the Occupational Safety and Health Act 1994. This course uses a case study learning approach.

9. IMK113/3 Management of Halal Food

This course introduces basic principles of Halal Haram and sources of food according to Syariah. This course also covers slaughtering method, hygiene and sanitation in the preparation of food for Muslims and processing of halal ingredients and additives including packaging, storage and transportation. In addition, this course will elaborate on the method and implementation of halal system in food industry.

10. IUK108/4 Statistic with Computer Applications

This course discusses on probability models for quality control of discrete random variation: random variation, cumulative distribution function, mean, variance and standard deviation. The course also discusses Discrete distribution: hypergeometric distribution, Binomial distribution, Poisson distribution, Continuous distribution, Normal distribution, exponential distribution and uses in reliability modelling.

11. IUK191/4 Mathematics I

This course introduces the concepts of functions and limits of single variable. Linear, polynomial, logarithmic, exponential and trigonometry functions will be discussed. The focus will be on the understanding of concept and solving of differentiation and integration with applications. Students are then introduced to differential equations focusing on separable differential equation and first-order linear equations. Matrices and determinants are taught in solving systems of linear equations by using Gauss and Cramer methods.

Level 200

12. IBG205/3 DNA and Metabolite Technology

The importance of gene cloning and genetically modified organism, genetic materials; chromosome, DNA, cloning vector; plasmid, cosmid, bacteriophage, DNA replication, protein synthesis, gene controlling, basic techniques in molecular genetics, gene cloning, metabolite production via recombinant DNA technology; bioethanol, use of glycerol, application of recombinant DNA technology in various industries; food, pharmaceutical, agriculture.

13. IBG207/3 Cell and Tissue Culture Technology

This course covers theoretical and practical knowledge on plant, insect and animal cell and tissue culture technology and its application in bioprocess technology fields. The course provides detailed information such as research methodology, current findings as well as advantages and disadvantages of three different types of cell culture systems. The topics covered in this course include media preparation, sterile techniques, aseptic handling, initiation and routine maintenance of cells in culture, common contaminants of plant and animal cell culture, and understanding of some of the applications of cell culture technology. This course also covers the fundamental biology of stem cells and its applications including the integration of gene therapy, chemical approach, extracellular matrices and the latest reprogramming technology related to stem cells.

14. IBG211/3 Bioanalysis II

This course covers the principals and methods of analytical instrumentation using spectroscopy analysis (UV/VIS spectrometry, Luminescence spectrometry, FTIR spectrometry, MS), chromatography (TLC, HPLC, GC, Gel Permeation Chromatography (GPC)), thermogravimetric analysis, thermal analysis (DSC, DTA), electrophoresis, polarimetry, and x-ray diffraction. Laboratory practise related to the topic are conducted.

15. IBG214/4 Enzyme Technology

This course covers properties and characteristics of enzyme, mode of reaction, reaction specificity. Source of enzyme, purification and characterisation. Factors affecting enzyme reaction: temperature, pH, enzyme concentration, substrate concentration, end-product concentration, activator, inhibitor. Quantitation of enzyme reaction, enzyme kinetics. Enzyme immobilisation techniques; immobilisation mechanism; advantage and disadvantage of immobilised enzyme. Application of enzyme in food and non-food industries: milk industry, detergent.

16. IBG215/4 Bioreactor Design, Calculation and Operation

Course Prerequisites: s IBG111/3

This course gives emphasis to the bioreactor design and operation, aeration and agitation, mode and types of fermentation. This course is also a combination of lectures and practical to focus on the skills of the students to operate various types of bioreactor types and operation.

17. IBK212/2 Renewable Biomass

This theoretical course will expose students to various type of renewable biomass materials that can be used as substrate in the production of different bioprocess products. Focus is emphasized on the importance of this renewable biomass in human life for decades to come. On the other hand, to various methods and technologies that involves in biomass conversion to value-added product such as chemical, biochemical and thermochemical method will be introduced to the students.

18. IBK215/2 Introduction to OMICs Technology

Course Prerequisites: s IBG205/3, s IMK227/3

This course is offered to expose the students to various disciplines in OMICS Technology that are widely used to understand and identify the dynamic functions and interactions between genes and proteins. The main topics involved in this course are Genomics, Transcriptomics, Proteomics, Metabolomics, Epigenomics and common techniques for each discipline. In addition, students will learn the applications of these technologies which include biomarker discovery, identification of signaling molecules associated with cell growth, cell death, cellular metabolism and early detection of cancer.

19. IBK218/2 Bioprocess Instrumentation and Measurement

This course covers the theory and criteria for measurement tools used in biological systems, design of complete measurement system including signal adjustment and component recording. Students are also exposed to the comparison between measurements in the physical and biological systems. This course also includes the mathematical description and identification of biological systems, interactions between biological and engineering systems, biological control systems, measurement tools and techniques involved in biological systems.

20. IEA216/3 Computer Applications in Industry

Course Prerequisites: s IEK101/3

This course introduces the student to the application of computers in Environmental Technology. The course comprises of two parts: a programming software and AutoCAD. The programming software part focuses on the use of computer programming in Environmental Technology. The student will be exposed to commands, the concept of function, statistical tools, and to the computer programming flow chart to develop a useful function to meet Environmental Technology challenges. The AutoCAD part exposes the student to the use of AutoCAD to produce engineering drawings that are clear and appropriate.

21. IEK212/3 Process Heat Transfer

Course Prerequisites: s IEK101/3

This course introduces the student to the fundamental principles of heat transmission by conduction, convection, radiation, and evaporation. This course will also discuss on the applications of these principles to the solution of industrial heat transfer problems and the design calculations for industrial heat exchanger equipment.

22. IEK213/3 Mass Transfer and Separation Processes

Course Prerequisites: s IEK101/3

This course introduces the students to the concepts and principles of mass transfer and separation processes. Additionally, unit operations, such as distillation, absorption, adsorption, humidification, filtration, centrifugation and drying, will be discussed.

23. IEK219/3 Treatment and Management of Scheduled Wastes

This course covers treatment and management of scheduled waste according to Environmental Quality (Scheduled Wastes) Regulation 2005. The management of scheduled wastes, from its generation until its disposal, is discussed. Environmental pollution prevention and minimization will also be elaborated. Physical, chemical, and biological treatments of scheduled waste will be summarized.

24. IMK221/3 Food Ingredients

This course covers aspects of food ingredients and additives usually used in food products. Different categories of these ingredients and additives will be discussed based on their specific functional properties. Examples will be given such as chemical and trade name, E-number, properties, toxicology and suitable level of usage in food.

25. IMK221/3 Biochemistry

This course includes acid-bass chemistry, structural and function of organelles cells, bio-energetic of cells (enzyme and kinetic, resistance and regulations, various metabolic roads). This course also includes replication transcription, DNA translation, gene expression and biochemical applications in the industry.

26. IUK208/3 Experimental Design with Computer Applications

This course discusses on the Replication, Randomisation, Blocking, and Definitions in Experimental Design (Experiment, Treatment, Factor, Level, Experimental unit, Experimental design, Random, Replicate).
Completely Randomised Design: Randomisation, Analysis of variance, equal replication and unequal replication, Estimation of the model Parameters, Comparison of Individual Treatment Means: Comparing of pair Treatment Means, Comparing with a control, orthogonal contrast.
Randomised Block Design: blocking, Randomised block design, Model and Assumptions, Missing values, Relative efficiency. Latin Square design Incomplete Block design: balanced incomplete block designs, Partially Balanced incomplete block designs.
Factorial Experiments (Designs): General factorial experiments, 2k Factorial experiment, 3k factorial experiment, Confounding, regression analysis, Response surface: Method of steepest ascent, Analysis of second-order model, Location of stationary point, Designs for fitting the first-Order and second-order models. Mixture experiments.

27. IUK291/4 Mathematics 2

Course Prerequisites: s IUK191/4

This course expands the concepts of functions and limits to two variables. Linear, polynomial, logarithmic, exponential and trigonometry functions will be discussed. The focus will be on the understanding and solving partial derivatives of differentiation and solving double and triple integration with simple applications. Students are then introduced to differential equations focusing on separable differential equation and second-order linear equations. Infinite series, Taylor-Maclaurin series and Fourier series are taught with a view to examine the theory and properties of certain functions that can be represented as sums of series.

Level 300

28. IBA306/8 Bioprocess Technology Research Project

Course is offered in TWO (2) semesters Course

This course will introduce the student to challenges relating to Technology. Through research, the student will attempt to solve the challenge. Lecturers will supervise the students in carrying out the literature search, laboratory work, and dissertation writing. The student will also attend a series of lectures on research philosophy, experimental design, scientific thinking, laboratory safety, thesis writing, Viva Voce presentation.

29. IBA312/3 Bioprocess and Society

This course describes the field of bioprocess technology and discusses the aspects and social implications in a technological solution. Discuss the question of ethics, social responsibility and selected issues. Emphasizes on the contribution of science toward local communities.

30. IBA319/4 Advanced Practical in Bioreactor Systems

This course emphasizes practical exercises of various types of bioreactor system. Theoretical principle for each bioreactor system and factors influencing the fermentation process will be discussed. This course also emphasizes bioreactor design, types, classification and selection for each system. Scaling up to pilot scale fermenter will be taught in general.

31. IBG307/3 Bioprocess Optimization and Simulation

Introduction to fermentation process and operation modes, optimization process. Kinetics and modeling of fermentation. Mass balance, estimation of kinetic parameter values; measurement of growth, rates of substrate consumption and product formation. Model of (batch, continuous, fed-batch) fermentation; simulation of growth in (batch, continuous, fed-batch) fermentation using statistical software and measurement of simulation parameters.

32. IBG319/4 Bioproduct Design and Development

The course covers theoretical knowledge and group project of marketable bioproduct design and development. Theoretical knowledge includes discussion on a case which analyzing factors of the declining and increasing product demand; product design principles; innovation strategy; knowledge in product development; consumer in product development and management in product development.

33. IBK314/3 Downstream Process Technology

This course is a theoretical course on the downstream processes that are required for separation, release, recovery, concentration and purification of products produced through fermentation, and will emphasize on concepts and methods that are commonly used for each stage of the downstream process.

34. IBK315/2 Bioinformatics

Course Prerequisites: s IBG205/3

This course is offered to expose the students to the Bioinformatics and steps to retrieve and analyze biological data such as DNA and protein sequences. The main topics involved in this course are the introduction of bioinformatics and the application of some databases to find DNA sequences and proteins using FASTA and BLAST. Several processes related to pairing and multiplication sequences are also emphasized in determining the similarity of the sequence. In addition, the course includes tutorials on some software and computing approaches used in Bioinformatics.

35. IBK316/3 Food Bioprocess Technology

This course covers the processing of food commodities (plants and animals) via the usage of enzymes, tissue cultures and microorganisms, with the aim of increasing quality and the production of value-added products. The production of food ingredients and additives, as well as food processing aids through bioprocessing will also be discussed (eg probiotics, enzymes, colouring) The use of foods from genetically modified microbial sources will also be studied and issues on concerns and acceptance by the community/ masses will also be discussed.

36. IBK317/3 Mathematical Physiology

This course introduces the knowledge mathematics modelling to answer human physiological questions and to predict the biological process. The focus of this course will be on the understanding of basic cell biology, human physiology and mathematical modelling. The course will also explain the used of mathematical physiology in the production of medical devices.

37. IBK318/3 Pharmacogenomic

This course will cover the knowledge on how gene influence individual's response towards medication. This course will also discuss on pharmacogenomics application in specific medicine production suitable for each individual.

38. IMK316/3 Food Quality Management and Food Regulations

This course introduces quality management system that is widely practiced in the food industry. This course covers food assurance, control, evaluation, and audit. The course is made complete with basic exposure to food laws and regulation.

39. IMK326/3 Food Safety

This course focuses on practices that will ensure production, processing and preparation of safe foods. Topics covered are type of contaminants, types of soils and their interaction with contact surfaces; various cleaning operations; election, application and safety of detergents and sanitizers; Code of Food Hygiene; Food safety management tools such as GMPs/GAPs/SSOP/HACCP, risk management, food toxicology and food allergens will also be covered in this course.

40. IUK303/3 Industrial Waste Management

This course exposes students to various industrial waste management practices in terms of philosophy and practical technology. Among practical philosophies are "Just-in-time", Lean Manufacturing, "5R", and zero waste management. Students will also be introduced to technologies used in sustainable industrial waste processing. This course also includes laws, regulations and protocols implemented in industrial waste management. In addition, students will conduct case studies and journals review as exposure to industrial waste management practices in developed and developing countries as well as recent research in sustainable industrial waste management.

Level 400

41. IBA406/12 Bioprocess Technology Industrial Training

This course involves placement of students to undertake internship in an industry. During the internship, students are able to gain an insight into industrial practices and appreciate how principles of science, technology and management are applied in the actual workplace.

42. IBA407/4 Practical in Downstream Processing

This course will enhance the techniques of downstream processing via laboratory practical. This course focuses on downstream processing, which are removal of insoluble, isolation of products and purification of products. In the aspects of insoluble removal, focus will be given to design of filtration, design of centrifugation and coagulation processes. In the aspect of product isolation, focus will be given to the design of solvent extractions, precipitation and adsorption. Purification will cover topics on design of separation process and application of chromatography techniques.

43. IBK411/3 Quality Assurance and Safety of Bioprocess Products

The course is related to legal import/export of food and biopharmaceutical products especially produced through the process of bioprocess technology. Students are exposed to the various quality management systems (Quality Management System, QMS), including a comprehensive quality management (total quality management, TQM), ISO 9001:2000, ISO 14000 and Halal. Statistical control process for interpretation of quality control data will be emphasized. Controlling method for quality products such as raw materials received, during the preparation, packing material and the packaging process and processing methods will be emphasized with the approach of good manufacturing practices (GMP). This course also includes the evaluation of bioprocess product safety and relevant risk assessment.

44. IBK412/3 Environmental Bioprocess Technology

Students are exposed to ethical issues and the effects of bioprocess industries on the environment. Aspects of regulation and design of treatment systems are emphasized to expose students to the existing and potential technology. Treatment systems including basin setting, anaerobic digester, lagoons and composting system will be discussed. Meanwhile, treatment with conversion industrial or domestic effluent to valuable products also will be discussed in detail.

45. IBK413/3 Protein Engineering

Course Prerequisites: s IBG205/3 & s IBK315/2

This course introduces to the methods and strategies in protein engineering and protein modification techniques. The theories and concepts behind rational design and directed evolution methods will be covered in this course. Students will also learn about the basics of protein structures and the related biophysical analyses along with the strategies of bioinformatic database searches. Topics of screening, isolation, expression and purification methods of novel protein variants with improved properties will also be covered in this course.

"Tell me and I forget. Teach me and I remember. Involve me and I learn"

–Benjamin Franklin–

Academic Staff

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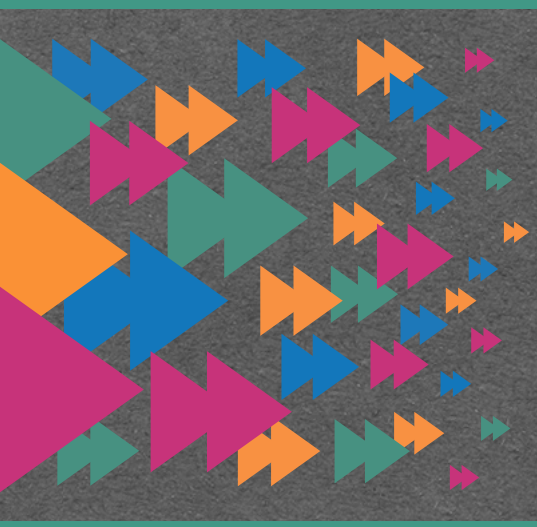

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