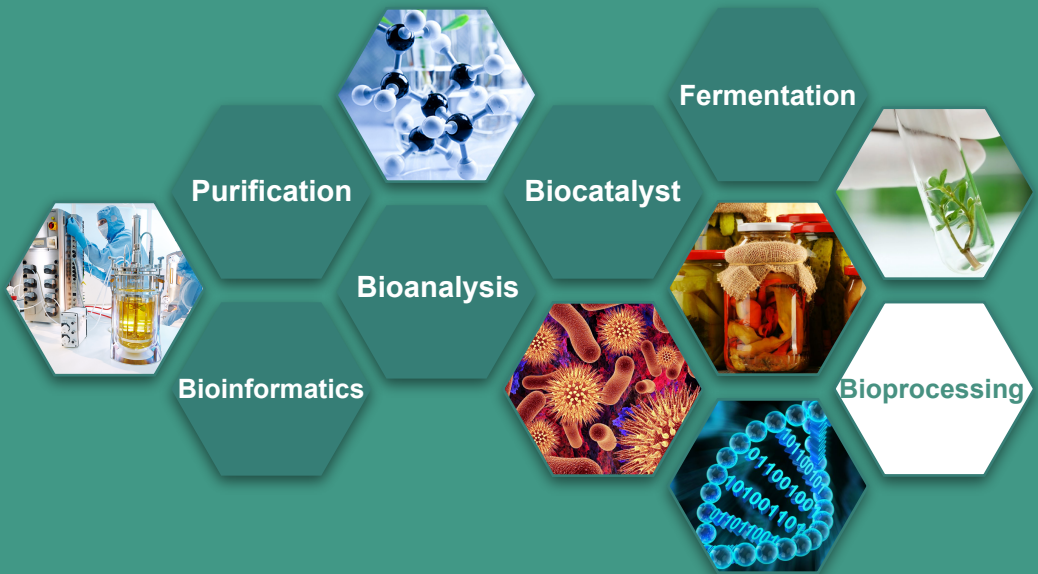




# Bachelor of Technology (Honours)

# **BIOPROCESS**

## ACADEMIC HANDBOOK



School of Industrial Technology  
Universiti Sains Malaysia  
[www.indtech.usm.my](http://www.indtech.usm.my)

**2019/2020**

**Academic Handbook  
Bachelor of Technology (Honours) (Bioprocess)  
Academic Calendar 2019/2020**

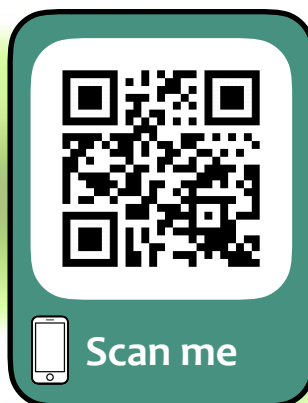
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Full version of the Academic Handbook

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

*“The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn.”*

*–Alvin Toffler–*

# 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.

## Administrative Staff



- |    |  |                                       |
|----|--|---------------------------------------|
| 1  | Dean   | Prof. Dr. Norli Ismail                |
| 2  | Deputy Dean (Research, Innovation & Industrial - Community Engagement) | Prof. Dato' Dr. Azhar Mat Easa        |
| 3  | Deputy Dean (Academic, Career & International)                         | Assoc. Prof. Dr. Yusri Yusup          |
| 4  | Programme Chairman (Food Technology)                                   | Assoc. Prof. Dr. Fazilah Ariffin      |
| 5  | Programme Chairman (Environmental Technology)                          | Assoc. Prof. Dr. Mardiana Idayu Ahmad |
| 6  | Programme Chairman (Bioresource, Paper & Coatings Technology)          | Assoc. Prof. Dr. Leh Cheu Peng        |
| 7  | Programme Chairman (Bioprocess Technology)                             | Dr. Lee Chee Keong                    |
| 8  | Senior Assistant Registrar (Academic & Administration)                 | Mdm. Rasslene Rass Rasalingam         |
| 9  | Senior Assistant Registrar (Postgraduate & Human Resource)             | Mdm. Nor Farah Shaik Omar             |
| 10 | Senior Research Officer  | Mr. Che Ku Abdullah Che Ku Alam       |
| 11 | Senior Science Officer   | Mr. Jeffiz Ezuer Shafii               |
| 12 | Science Officer  | Mr. Mohd Syukri Baharudin             |

## Programme Outcomes

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

1. Acquire the knowledge and skills in the area of technology specialised (Knowledge)
2. Exhibit extensive technical skills in the area of specialisation (Technical Skill, Practical Skill, Psychomotor)
3. Identify and resolve issues and problems in a critical, creative, and innovative manner (Thinking Skill and Scientific Approach)
4. Acquire the skill to communicate effectively in all walks of life (Communication Skill)
5. Display a sense of responsibility and master social skills (Social and Responsibility Skill)
6. Understand and manage the industry in a professional and ethical manner (Professionalism, Value, Attitude and Ethics)
7. Manage current information and recognise the importance of lifelong learning (Lifelong Education and Information Management)
8. Acquire entrepreneurial knowledge base for career development (Management and Entrepreneurship Skill)
9. Function effectively as an individual and in a team with the ability to lead (Leadership Skill)

## 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 the 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 mentor 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

## Academic Programme

The School of Industrial Technology offers the following bachelor degrees:

- Bachelor of Technology (Honours) (Food)
- Bachelor of Technology (Honours) (Bioresource, Paper and Coatings)
- Bachelor of Technology (Honours) (Environment)
- Bachelor of Technology (Honours) (Bioprocess)

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, Paper and Coatings and Environmental Technologies) or 400 (Food and Bioprocess 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 weeks. This training is aimed at exposing the students to actual working practice and atmosphere of the industry.

## General Educational Goal & Objectives

The general goal of Bachelor of Technology degree programme is to produce graduates who have specialised expertise in their respective technologies (Food, Bioprocess, Environment, and Bioresource, Paper and Coatings) to meet the employment needs of the country for various related industries/agencies.

Therefore, the academic programmes are designed to produce graduates who:

- are competent to work and able to solve problems
- have communication and team work skills
- have leadership skills, positive attitude and professional ethics
- are capable of contributing to the well-being of the society and sustainability of the environment
- have interest in entrepreneurship and lifelong learning

# Bioprocess Technology

Bioprocess Technology is the sub-discipline within Biotechnology that combines living matter, in the form of organisms or enzymes, with nutrients under specific optimal conditions to make a desired product. It is responsible for translating discoveries of life sciences into practical and industrial products, processes and techniques that can serve the needs of society. Bioprocess Technology is thus the backbone of the biotechnology industry that translates the research and development to the industries. The stages involved in Bioprocess 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.

The Bioprocess 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.

## Details of Programme

Type of Programme	Structure of Programme
Bachelor of Technology with Elective	Students choose several elective courses to widen their specialisation area and their knowledge in industrial technology.
Bachelor of Technology with Minor	Students choose and complete one minor area offered by other schools. <ul style="list-style-type: none"><li>● Starting at the beginning of the second semester of Year I.</li></ul>



## Programme Requirements

Course Code Classification	Normal Programme	Minor Programme	Min. Total Unit Requirements
T	77	77	130
E	33	13	
M	0	20	
U	20	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.

M (Minor Courses) – minor specialisation offered by another school.

U (University Requirements) – courses to fulfil the University requirements.

## 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/ Minor and University courses/Option).
- ☑ Obtained a CGPA of 2.00 and above for Core components.
- ☑ Obtained a CGPA of 2.00 and above for the programme.
- ☑ Achieved a minimum of 'C' grade or a grade point of 2.00 for Bahasa Malaysia, English Language (4 units), TITAS, Ethnic Relations, and Core Entrepreneurship.

# University Requirements for Graduation

LOCAL STUDENTS		INTERNATIONAL STUDENTS	
Compulsory Courses	Units	Compulsory Courses	Units
❖ LKM400/2 Bahasa Malaysia IV	2	❖ LKM100/2 Bahasa Malaysia I	2
English Language (MUET Band 6)		❖ English Language courses	4
❖ (LHP451/452/453/454/455/456/457/458/459) and/or		* Students may obtain advice from the School of Languages, Literacies and Translation if they have different English Language Qualification.	
❖ 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 2 – 4)	4		
❖ LSP300/2 Academic English and			
❖ LSP402/2 Scientific and Medical English			
English Language (MUET Band 2 – 3)			
❖ LMT100/2 Preparatory English* or			
❖ Re-sit MUET			
* Prerequisite for LSP300/2 Academic English			
❖ HTU223/2 Islamic and Asian Civilisations (TITAS)	2	❖ SEA205E/4 Malaysian Studies	4
❖ SHE101/2 Ethnic Relations	2	❖ Option/Bahasa Malaysia/English Language	2
❖ WUS101/2 Core Entrepreneurship	2		
❖ Co-curricular	2	❖ Co-curricular	2
Optional Courses	Units	Optional Courses	Units
❖ Co-curricular/Skills Courses/Foreign Language Courses/Options		❖ Co-curricular/Skills Courses/Foreign Language Courses/Options	
❖ WSU101/2 Sustainability: Issues, Challenges & Prospect	6	❖ WSU101/2 Sustainability: Issues, Challenges & Prospect	6
❖ HTV201/2 Thinking Techniques		❖ HTV201/2 Thinking Techniques	
Minimum Requirements	20	Minimum Requirements	20

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





# List and Synopsis of Courses

## Level 100

### 1. IBG102/3 Biology for Technologists

This course discusses the importance of the Biology discipline as a source of raw materials in the development of the field of Bioprocess. Biological sources comprising of microorganisms, plants and animals are the sources of biological materials of commercial value, e.g. biological biomass, metabolites, natural extracts, pharmaceuticals, macromolecules, etc. Components of biological sources with importance as industrial sources will be discussed. Discussion covers the major macromolecule, biological characteristics, material composition, extraction methods, control of production of the materials and their uses in industrial processes. Various basic techniques and skills in the handling and analysis of biological sources, detecting the presence of the desired biological materials and ensuring the stability of activity will be learned.

### 2. IBG111/3 Industrial Microbiology

**Course Prerequisites:** s IBG102/3

This course discusses the involvement of microorganisms in industrial processes, specifically in the production of various product materials including enzymes, food, beverages, fuels, pharmaceuticals, 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 microorganisms 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 analyse bioprocess product, such as carbohydrates, protein, amino acids, and lipids. Laboratory practise 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. IMK105/2 Biochemistry

This course covers the acid-base chemistry, structure and functions of cell organelles, cell bioenergetics (enzymes kinetics, inhibition and regulation, various metabolic pathways). The course also covers DNA replication, transcription, translation and gene expression.

### 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

This course covers 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 etc, application of recombinant DNA technology in various industries; food, pharmaceutical, agriculture, and etc.

### 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, Fourier Transform Infra-Red (FTIR) spectrometry, Mass spectrometry (MS)], chromatography [Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC), Gel Permeation Chromatography (GPC)], thermogravimetric analysis, thermal analysis [Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA)], electrophoresis, polarimetry, and x-ray diffraction. Laboratory practise related to the topic are conducted.

### 15. IBG213/4 Bioreactor 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 practicals to focus on the skills of the students to operate various types of bioreactor types and operation.

### 16. 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.

### 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 emphasised 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. IBK216/2 Bioprocess Instrumentation and Control

**Course Prerequisites:** s IBG213/4

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.

### 19. 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.

### 20. 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.

### 21. 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.

### 22. 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.

## Level 300

### 23. IBA304/6 Bioprocess Technology Industrial Training

**Course Prerequisites:** Students have completed FOUR (4) semesters of study, regardless of the accumulated units.

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

### 24. IBA317/3 Practical in Bioreactor System

**Course Prerequisites:** s IBG213/4

This course emphasises practical exercises of various types of bioreactor system (stirred tank, air-lift, etc) and different modes of fermentation. Three modes of fermentation which are continuous; fed batch and solid state will be taught. Theoretical principle for each mode of fermentation as well as factors influencing the fermentation process will be discussed. This course also emphasises bioreactor design, types, classification and selection for each system. Scaling up from laboratory scale fermentation to pilot scale fermenter will be taught in general.

### 25. IBG307/3 Bioprocess Optimization and Simulation

**Course Prerequisites:** s IBG213/4

This course covers introduction to fermentation process, different operation modes, design of experiment and optimisation process. Kinetics and modelling of fermentation; kinetic models, simulation tools. Basic mass balance; mass balance as inspection data, process in a balanced condition. Estimation of kinetic parameter values; measurement of growth, rates of substrate consumption, rates of product formation, environmental factors affecting growth rate. Model of batch fermentation; simulation of growth in the batch fermentation and measurement of simulation parameters. Model of continuous fermentation; simulation of growth in the continuous fermentation and measurement of simulation parameters. Model of fed-batch fermentation; simulation of growth in the fed-batch fermentation and measurement of simulation parameters.



### 26. IBK312/3 Issues in Bioprocess Technology

This course describes the field of bioprocess technology and discusses the aspects and social implications in a technological solution. Express the difference between the profession of engineers and technologists, especially for bioprocess. Discuss the question of ethics, social responsibility, selected issues and laws.

### 27. IBK314/3 Downstream Process Technology

*Course Prerequisites: s IBG213/4*

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 emphasise on concepts and methods that are commonly used for each stage of the downstream process.

### 28. IBK315/2 Bioinformatics

This course is offered to expose the students to the Bioinformatics and steps to retrieve and analyse 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 emphasised in determining the similarity of the sequence. In addition, the course includes tutorials on some software and computing approaches used in Bioinformatics.

### 29. 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 (e.g. probiotics, enzymes, monosodium glutamate) The use of foods from genetically modified microbial sources will also be studied and issues on regulation and acceptance of the community/ masses will also be discussed.

### 30. 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.

### 31. 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

#### 32. IBA404/8 Bioprocess Technology Research Project

**\*\*Course is offered in TWO (2) semesters**

**Course Prerequisites:**

- (i) **Students must take all core courses of levels 100, 200, and 300.**
- (ii) **Students have collected at least 50 credit units of core courses.**

This course will introduce the student problems relating to Bioprocess Technology. Through research, the student will be tasked to solve the problem. 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.

#### 33. IBA405/3 Practical in Downstream Processing

**Course Prerequisites: s IBK314/3**

This course will enhance the techniques of downstream processing via laboratory practical. This course focuses on downstream processing, which are removal of insolubles, 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.

#### 34. IBK402/4 Bioproduct Development

This course covers the development of new bioproducts into new and old markets. Various factors which will affect the suitability of a product in the market will be taught and identified. These include the quality of the bioproduct produced, skills and resources of a company, market, marketing strategies and product development process. Other human factors will also be taught, such as consumer behaviour. Technological skills and organising skills will also be covered. Students working in groups need to develop a bioproduct, present their developed product, report the development progress and display the resulting product to the public.

#### 35. IBK411/3 Quality Assurance and Safety of Bioprocess Products

This 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 emphasised. Controlling method for quality products such as raw materials received, during the preparation, packing material and the packaging process and processing methods will be emphasised with the approach of good manufacturing practices (GMP). This course also includes the evaluation of bioprocess product safety and relevant risk assessment.

#### 36. IBK412/3 Environmental Bioprocess Technology

This course will expose students to ethical issues and the effects of bioprocess industries on the environment. Aspects of regulation and design of treatment systems are emphasised 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 detail.

## Minor Programmes

All students that choose to do Industrial Technology with Minor programme must choose one minor programme and commence their minor study in the second semester of the first year of their studies. These students must complete 20 units of the courses in the minor package.

Among the minor programmes offered are:

School	Minor Package	Code
School of Biological Sciences	Biology	oB01
School of Physics	Physics	oZ01
School of Chemical Sciences	Chemistry	oK01
School of Mathematical Sciences	Mathematics	oM01
School of Humanities	English Language	oH01
	Malay Linguistics	oH02
	Geography	oH03
	Literature	oH04
	Islamic Studies	oH05
	History	oH06
	Japanese Studies	oH11
	Philosophy and Civilisations	oH15
	Translation and Interpretation	oH14
	School of Language, Literacies, & Translation	Japanese Language Studies
Chinese Language Studies		oL02
Communicational Arabic		oL06
School of Art	Fine Arts	oH07
	Performing Arts	oH08
	Musics	oH09
	Drama and Theatre	oH10
	Communicational Graphics	oH12
	Acting and Directing	oH13
	Music Technology	oV01
School of Communication	Communication Studies	oY05
	Science and Environment Journalism	oY06
	Management	oA03
Centre for Global Archeological Research	Archeology	oU01

School	Minor Package	Code
School of Social Science	Anthropology and Sociology	oS01
	Economics	oS02
	Social Development and Administration	oS04
	Political Science Development	oS05
	Planning and Management	oS07
	Industrial Relation Public	oS08
	Policy and Administration	oS09
	International Relation	oS10
	South-East Asian Studies	oS11
	Psychology	oS12

The following minor programmes are popular among students of the School of Industrial Technology:

**(a) Communication Studies (oY05)**

No.	Code/Units/Course Title
<b>A. Compulsory (9 credits)</b>	
<b>i) Choose any 1 course (3 credits)</b>	
1.	YKT101/3 Introduction to Human Communication
2.	YKT102/3 Introduction to Mass Communication
3.	YKT104/3 Introduction to Communication Studies
<b>ii) Choose any 2 courses (6 credits)</b>	
4.	YKT218/3 Communication Theory 1
5.	YKT220/3 Communication Theory 2
6.	YBP201/3 Communication for Sustainable Development
<b>B. Choose (11 credits)</b>	
7.	YFP324/3 Cinema Studies
8.	YFP321/3 Television Studies
9.	YBP224/3 Public Relations
10.	YBP326/3 Corporate Communication
11.	YBP300/3 Integrated Marketing Communication
12.	YWP223/3 Feature Writing
13.	YKT221/3 Media Laws and Ethics
14.	YWP315/3 Media and Gender

**(b) Psychology (oS12)**

No.	Code/Units/Course Title
1.	STU231/4 Foundation in Psychology ( <i>Compulsory</i> ) <b>Choose any 3 courses (12 credits)</b>
2.	STU241/4 Health Psychology
3.	STU242/4 Social Psychology
4.	STU243/4 Development Psychology
5.	STU244/4 Abnormal Psychology
6.	STU337/4 Counselling

**(c) Management (oA03)**

No.	Code/Units/Course Title	Title Semester
1.	AKW103/4 Introduction to Management	I & II
2.	AKW104/4 Accounting and Finance	I & II
3.	AKP201/4 Marketing	I & II
4.	AKP202/4 Organisational Behaviour	I & II
5.	AKP302/4 Operation Management	I & II

Course 1 and 2 are compulsory and pre-requisites to other courses.

**(d) Economics (oS04)**

No.	Code/Units/Course Title
1.	SKE109/3 Principles to Economics Issues ( <i>Compulsory</i> ) - Sem. II
2.	SEW101/3 Microeconomics ( <i>Compulsory</i> ) - Sem. II
3.	SEW103/3 Macroeconomics ( <i>Compulsory</i> ) - Sem. II <b>Choose any 3 courses (11 credits)</b>
4.	SEU226/4 Labour Economics
5.	SEU228/4 Malaysian Economy
6.	SEU333/3 Industrial Organisation
7.	SEU334/3 Money, Banking and Financial Markets
8.	SEU336/3 Environmental and Natural Resources Economics
9.	SEU339/3 Economic Planning and Project Analysis

(e) Islamic Studies (oHo5)

No.	Code/Units/Course Title
<b>Package A (12 credits)</b>	
1.	HIA101/4 Introduction to Islamic Studies ( <i>Compulsory Grade C</i> )
2.	HIU123/4 The Islamic Creed: Concept and Realisation
3.	HIS213/4 Sources and Principles of Islamic Laws
<b>Package B (8 credits)</b>	
4.	HIS224/4 The Islamic Family Institution
5.	HIU226/4 Akhlaq and Islamic Spiritual
6.	HIS311/4 Zakat and Wakaf
7.	HIS315/4 Mu'amalat: Concept and Application
8.	HIU321/4 Al-Quran, Tawhid, and Science

For students wishing to register for minor programme, please make sure that time-tabling and course scheduling allows you to graduate in the stipulated period. See Minor Programmes Handbook for further information on Minor Specialisations.

*“Tell me and I forget. Teach me and I remember. Involve me and I learn”*

*–Benjamin Franklin–*

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Prof. Dato' Dr. Azhar Mat Easa

Prof. Dr. Abd. Karim Alias

Prof. Dr. Mahamad Hakimi Ibrahim

Prof. Dr. Norli Ismail

Prof. Dr. Rokiah Hashim

Prof. Dr. Wan Rosli Wan Daud

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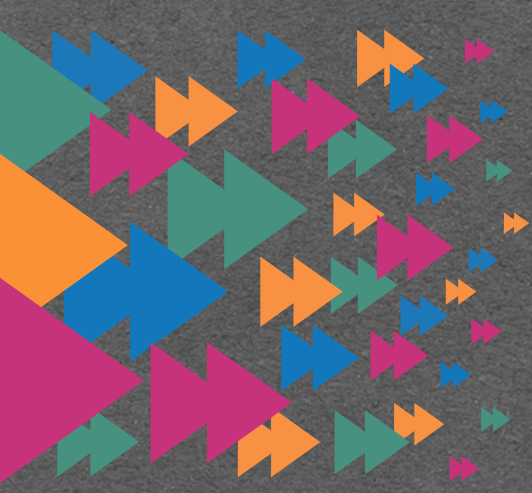
Dr. Nor Shariffa Yussof

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School of Industrial Technology  
Universiti Sains Malaysia  
11800 USM, Pulau Pinang, Malaysia  
Tel. no.: +604-653 2219/2260 | Fax no.: +604-653 6375  
Email: [dean\\_ind@usm.my](mailto:dean_ind@usm.my)