

FAKULTI BIOTEKNOLOGI DAN SAINS BIOMOLEKUL

Maklumat Am

Fakulti Bioteknologi dan Sains Biomolekul (FBSB) telah ditubuhkan pada 1hb Ogos 2004 yang menggabungkan dua buah jabatan iaitu Jabatan Bioteknologi di Fakulti Sains Makanan dan Bioteknologi dan Jabatan Biokimia dan Mikrobiologi di Fakulti Sains dan Pengajian Alam Sekitar bagi memberikan penumpuan dan penekanan kepada bidang bioteknologi. Dengan tertubuhnya FBSB, semua aktiviti yang melibatkan bioteknologi dan sains biomolekul di UPM dapat dijalankan dibawah satu pentadbiran.

Penubuhan empat jabatan di FBSB iaitu Jabatan Biokimia, Jabatan Mikrobiologi, Jabatan Teknologi Bioproses dan Jabatan Biologi Sel dan Molekul menawarkan kursus yang boleh dijadikan sebagai teras program pengajian jabatan di samping menawarkan kursus teras atau kursus elektif bagi program atau keutamaan lain. Selain dari pengajaran, pegawai akademik juga terlibat di dalam penyelidikan, pengembangan dan perundingan.

Walaupun fakulti baharu menjangkau umur 10 tahun, FBSB mempunyai kepakaran tenaga mahir dan pelbagai makmal yang dilengkapi dengan kemudahan dan peralatan asas dan berteknologi tinggi bagi menyokong aktiviti pengajaran, penyelidikan dan perkhidmatan profesional dalam bidang bioteknologi dan sains biomolekul. Semua pegawai akademik adalah berpengalaman dan mempunyai kemahiran teknikal yang luas dalam bidang kepakaran masing-masing. Buat masa ini terdapat 13 Profesor, 15 orang Professor Madya, 30 orang Pensyarah dan 17 orang Tutor.

Kini, Fakulti menawarkan empat (4) program pengajian di peringkat Bachelar. Program pengajian yang ditawarkan adalah Bachelar Sains (Kepujian) Biokimia, Bachelar Sains (Kepujian) Mikrobiologi, Bachelar Sains (Kepujian) Bioteknologi dan Bachelar Sains (Kepujian) Biologi Sel dan Molekul.

FACULTY OF BIOTECHNOLOGY AND BIOMOLECULAR SCIENCES

General Information

The Faculty of Biotechnology and Biomolecular Sciences (FBBS) was established on 1st August 2004 with the merger of two departments, the Department of Biotechnology from the Faculty of Food Science and Biotechnology and the Department of Biochemistry and Microbiology from the Faculty of Science and Environmental Studies, for greater focus and emphasis on the field of biotechnology. With the formation of FBBS, all activities related to biotechnology and biomolecular sciences at UPM are now under one administration.

Four departments namely Department of Biochemistry, Department of Microbiology, Department of Bioprocess Technology and Department of Biology Cell and Molecule were established. Each department in FBBS offers core and elective courses for its own programs as well as other programs or majors. Apart from teaching, research, development and consultancy are the forte of this Faculty.

Although faculty just at 10 years of age, FBBS has the necessary expertise and is equipped with basic and high-tech facilities and equipment which support teaching, research and professional services in the field of biotechnology and biomolecular sciences. The academic staff comprises experienced lecturers respected in their respective fields of expertise, and young enthusiastic PhD holders with advanced technical knowledge trained in some of the best laboratories all over the world. Currently the Faculty is staffed by 14 Professors, 15 Associate Professor, 30 lecturers and 17 tutors.

At present the Faculty offers four (4) academic programs at the Bachelor's degree level. The programs offered are Bachelor of Science (Hons) in Biochemistry, Bachelor of Science (Hons) in Microbiology, Bachelor of Science (Hons) in Biotechnology and Bachelor of Science (Hons) in Cell and Molecular Biology.

Pengurusan Fakulti/ *Faculty Management*

Dekan/ *Dean*

Prof. Datin Paduka Dr. Khatijah Yusoff

Timbalan Dekan (Akademik & Hal Ehwal Pelajar)

Deputy Dean of Academic & Student Affairs

Prof. Dr. Suraini Abd. Aziz

Timbalan Dekan (Penyelidikan & Pengajian Siswazah)

Deputy Dean of Research & Postgraduate Studies

Prof. Madya Dr. Norazizah Shafee

Ketua Jabatan Mikrobiologi

Head, Dept. of Mikrobiology

Prof. Madya Dr. Muhajir Hamid

Ketua Jabatan Biokimia

Head, Dept. of Biochemistry

Prof. Dato' Dr. Abu Bakar Salleh

Ketua Jabatan Biologi Sel & Molekul

Head, Dept. of Cell & Molecular Biology

Prof. Madya Dr. Mohd. Puad Abdullah

Ketua Jabatan Teknologi Bioproses

Head, Dept. of Bioprocess Technology

Prof. Madya Dr. Rosfarizan Mohamad

Ketua Penolong Pendaftar

Chief Assistant Registrar

En. Amiruddin Abd Aziz

Program Prasiswazah yang ditawarkan

Bachelor / *Bachelor*

1. Bacelor Sains (Kepujian) Biokimia / *Bachelor of Science (Honours) Biochemistry*
2. Bacelor Sains (Kepujian) Mikrobiologi / *Bachelor of Science (Honours) Microbiology*
3. Bacelor Sains (Kepujian) Bioteknologi / *Bachelor of Science (Honours) Biotechnology*
4. Bacelor Sains (Kepujian) Biologi Sel dan Molekul / *Bachelor of Science (Honours) Cell and Molecular Biology*

STRUKTUR KURIKULUM/ CURRICULUM STRUCTURE

Nama Program : **Bachelor Sains (Kepujian) Biokimia/ Bachelor of Science (Honours) Biochemistry**

Jumlah Kredit Bergraduat : **127 Jam Kredit/ Credit Hours**

Tempoh Pengajian : **8 Semester/ Semesters (4 Tahun/ Years)**

1. Kursus Universiti/ University Courses (23 kredit/ credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BBI2423	Academic Interaction and Presentation	3	2	1
BBI2424	Academic Writing	3	2	1
MGM3180	Asas Keusahawanan/ Basic Entrepreneurship	3	2	1
PRT2008	Pertanian dan Manusia/ Agriculture and Man	2	2	0
SSK3000	Teknologi Maklumat dan Penggunaannya/ Information Technology and Its Applications	3	2	1
SKP2101	Kenegaraan Malaysia/ Malaysian Nationhood	3	3	0
SKP2203	Tamadun Islam dan Tamadun Asia/ Asian and Islamic Civilizations	2	2	0
SKP2204	Hubungan Etnik/ Ethnic Relation	2	2	0
	Kokurikulum/ Co-curriculum	2	0	2

2. Kursus Teras/ Core Courses (72 kredit/ credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3100	Pengiraan Asas dalam Biokimia/ Basic Calculations in Biochemistry	2	1	1
BCH3101	Biomolekul/ Biomolecules	4	4	0
BCH3102	Enzimologi/ Enzymology	4	3	1
BCH3103	Metabolisme Karbohidrat/ Carbohydrate Metabolism	3	3	0
BCH3104	Metabolisme Protein dan Asid Nukleik/ Protein and Nucleic Acid Metabolism	3	3	0
BCH3105	Metabolisme Lipid dan Membran/ Lipid Metabolism and Membranes	3	3	0
BCH3200	Instrumentasi dalam Biokimia/ Instrumentation in Biochemistry	3	1	2
BCH3201	Analisis Biomolekul/ Analysis of Biomolecules	2	1	1
BCH3202	Praktikal Metabolisme/ Practicals in Metabolism	2	1	1
BCH4101	Biokimia Hormon/ Biochemistry of Hormones	3	3	0
BCH4901	Latihan Industri/ Industrial Training	6	0	6
BCH4992	Topik Terkini Biokimia/ Current Topics in Biochemistry	2	0	2

BCH4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BCH4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
CHM3010	Kimia Fizik dan Tak Organik/ <i>Physical and Inorganic Chemistry</i>	4	3	1
CHM3201	Kimia Organik I/ <i>Organic Chemistry I</i>	4	3	1
BSM3101	Biologi Sel dan Perkembangan/ <i>Cellular and Developmental Biology</i>	3	3	0
BSM3201	Biologi Molekul/ <i>Molecular Biology</i>	3	3	0
BSM4301	Bioinformatik/ <i>Bioinformatics</i>	3	2	1
BMY3001	Mikrobiologi/ <i>Microbiology</i>	4	4	0
BMY3201	Amali Mikrobiologi I/ <i>Practicals in Microbiology I</i>	2	0	2
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1

3. Kursus Elektif/ *Elective Course* (32 kredit/ *credits*)

KOD KURSUS/ <i>COURSE CODE</i>	NAMA KURSUS/ <i>COURSE NAME</i>	Kr	K	A
Kursus Elektif Sains dan Teknologi/ <i>Science and Technology Elective Courses</i> (20 kredit/ <i>credits</i>)				
BCH4301	Biokimia Tumbuhan/ <i>Plant Biochemistry</i>	3	3	0
BCH4302	Manipulasi Genetik Tumbuhan/ <i>Plant Genetic Manipulation</i>	3	2	1
BCH4303	Penggunaan Biokimia dalam Industri/ <i>Industrial Applications of Biochemistry</i>	3	3	0
BCH4304	Biokimia Makanan/ <i>Food Biochemistry</i>	3	3	0
BCH4305	Biokimia Pemakanan/ <i>Nutritional Biochemistry</i>	3	3	0
BCH4306	Biokimia Tisu Haiwan/ <i>Biochemistry of Animal Tissues</i>	3	3	0
BCH4307	Biokimia Alam Sekitar/ <i>Environmental Biochemistry</i>	3	3	0
BTC4204	Mikrobiologi Industri/ <i>Industrial Microbiology</i>	4	3	1
BTC3201	Teknologi Fermentasi/ <i>Fermentation Technology</i>	4	3	1
BTC3002	Komersialisasi dan Isu Semasa Bioteknologi/ <i>Commercialisation and Current Issues in Biotechnology</i>	2	2	0
BTC3401	Pengurusan dan Penggunaan Sisa/ <i>Waste Management and Utilisation</i>	2	2	0
BMY4201	Teknik Khas dalam Mikrobiologi/ <i>Specialised Techniques in Microbiology</i>	3	0	3
BMY4301	Bakteriologi/ <i>Bacteriology</i>	3	3	0
BMY4302	Virologi/ <i>Virology</i>	3	3	0
BMY4303	Mikologi/ <i>Mycology</i>	3	3	0
BMY4304	Imunologi/ <i>Immunology</i>	3	3	0
BMY4305	Ekologi Mikrob/ <i>Microbial Ecology</i>	3	3	0
BMY4308	Genetik Mikrob/ <i>Microbial Genetics</i>	3	3	0
BSM3202	Kejuruteraan Genetik/ <i>Genetic Engineering</i>	4	3	1

Kursus Elektif Pengurusan Dan Kemanusiaan / <i>Management and Humanities Elective Course</i> (6 kredit/ <i>credits</i>)				
ACT2112	Perakaunan Pengenalan/ <i>Introductory Accounting</i>	4	3	1
ACT2131	Perakaunan Kos dan Pengurusan/ <i>Introductory Accounting</i>	3	3	0
ACT3211	Pengurusan Kewangan/ <i>Financial Management</i>	3	3	0
ECN3100	Prinsip Ekonomi/ <i>Principles of Economics</i>	3	3	0
MGM3101	Prinsip Pengurusan/ <i>Principles of Management</i>	3	3	0
MGM3113	Gelagat Organisasi/ <i>Organizational Behavior</i>	3	3	0
MGM3211	Prinsip Pemasaran/ <i>Principles of Marketing</i>	3	3	0
MGM4174	Pengurusan Perkhidmatan/ <i>Services Management</i>	3	3	0
MGM4184	Pengurusan Perniagaan Kecil/ <i>Small Business Management</i>	3	3	0
Kursus Elektif Bebas : Pelajar perlu mengambil 6 kredit kursus elektif di fakulti lain dengan kebenaran Jabatan				

Nota/ Notes : Kr = Jam Kredit/ *Credit Hour*, K = Kuliah/ *Lecture*, A = Amali/ *Laboratory*, T = Tutorial

Nota / Notes :

1. Pelajar diwajibkan memilih 2 kredit daripada kursus kokurikulum yang ditawarkan oleh universiti / *It is compulsory for students to take 2 credits of co-curriculum courses offered by the university*
2. Pelajar perlu melengkapkan pakej keperluan bahasa inggeris seperti jadual di bawah :
(Butiran lanjut mengenai CEL dan LAX sila rujuk di muka surat belakang buku panduan ini)
Students need to complete the english package as the table below : For more details on CEL and LAX please refer to the back/last page of this book.

MUET Band	Graduation Requirements for 4-year programmes
1 & 2	3 BBI + 3 CEL + 24 LAX points
3 & 4	2 BBI + 2 CEL + 36 LAX points
5 & 6	3 CEL + 36 LAX points

SKEMA PENGAJIAN/ STUDY SCHEMETAHUN 1/ 1ST YEARSEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3100	Pengiraan Asas dalam Biokimia/ <i>Basic Calculations in Biochemistry</i>	2	1	1
BCH3101	Biomolekul/ <i>Biomolecules</i>	4	4	0
BSM3101	Biologi Sel dan Perkembangan/ <i>Cellular and Developmental Biology</i>	3	3	0
CHM3201	Kimia Organik I/ <i>Organic Chemistry I</i>	4	3	1
SKP2203	Tamadun Islam dan Tamadun Asia/ <i>Asian and Islamic Civilizations</i>	2	2	0
	Kokurikulum/ <i>Co-curriculum</i>	1	0	1
	JUMLAH/ TOTAL	16	13	3

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3102	Enzimologi/ <i>Enzymology</i>	4	3	1
CHM3010	Kimia Fizik dan Tak Organik/ <i>Physical and Inorganic Chemistry</i>	4	3	1
BMY3001	Mikrobiologi/ <i>Microbiology</i>	4	4	0
MGM3180	Asas Keusahawanan/ <i>Basic Entrepreneurship</i>	3	2	1
SKP2204	Hubungan Etnik/ <i>Ethnic Relation</i>	2	2	0
	Kokurikulum/ <i>Co-curriculum</i>	1	0	1
	JUMLAH/ TOTAL	18	14	4

TAHUN 2/ 2ND YEARSEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3103	Metabolisme Karbohidrat/ <i>Carbohydrate Metabolism</i>	3	3	0
BCH3201	Analisis Biomolekul/ <i>Analysis of Biomolecules</i>	2	1	1
BBI2423	Academic Interaction and Presentation	3	2	1
SKP2101	Kenegaraan Malaysia/ <i>Malaysian Nationhood</i>	3	3	0
BMY3201	Amali Mikrobiologi I/ <i>Practicals in Microbiology I</i>	2	0	2
BCH xxxx	Elektif Sains dan Teknologi (Kursus BCH)/ <i>Elective science and technology(BCH Courses)</i>	3		
	JUMLAH/ TOTAL	16		

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3104	Metabolisme Protein dan Asid Nukleik/ <i>Protein and Nucleic Acid Metabolism</i>	3	3	0
BCH3202	Praktikal Metabolisme/ <i>Practicals in Metabolism</i>	2	1	1
BBI2424	<i>Academic Writing</i>	3	2	1
BSM3201	Biologi Molekul/ <i>Molecular Biology</i>	3	3	0
	Elektif/ <i>Elective</i>	3		
	Elektif Sains dan Teknologi (Kursus BCH)/ <i>Elective science and technology(BCH Courses)</i>	4		
JUMLAH/ TOTAL		18		

TAHUN 3/ 3RD YEAR

SEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3105	Metabolisme Lipid dan Membran/ <i>Lipid Metabolism and Membranes</i>	3	3	0
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1
BSM4301	Bioinformatik/ <i>Bioinformatics</i>	3	2	1
SSK3000	Teknologi Maklumat dan Penggunaannya/ <i>Information Technology And Its Applications</i>	3	2	1
PRT2008	Pertanian dan Manusia/ <i>Agriculture and Man</i>	2	2	0
BCH xxxx	Elektif Sains dan Teknologi (Kursus BCH)/ <i>Elective science and technology(BCH Courses)</i>	3		
JUMLAH/ TOTAL		18		

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH4901	Latihan Industri/ <i>Industrial Training</i>	6	0	6
BCH3200	Instrumentasi dalam Biokimia/ <i>Instrumentation in Biochemistry</i>	3	1	2
BCH4101	Biokimia Hormon/ <i>Biochemistry of Hormones</i>	3	3	0
JUMLAH/ TOTAL		12	4	8

SEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH4992	Topik Terkini Biokimia/ <i>Current Topics in Biochemistry</i>	2	0	2
BCH4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
	Elektif Sains dan Teknologi/ <i>Elective science and technology(BCH Courses)</i>	7		
	Elektif Pengurusan dan Kemanusiaan/ <i>Elective Management and Humanities</i>	3		
	JUMLAH/ TOTAL	16		

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
	Elektif Sains dan Teknologi/ <i>Elective science and technology(BCH Courses)</i>	3		
	Elektif Pengurusan dan Kemanusiaan/ <i>Elective Management and Humanities</i>	3		
	Elektif/ <i>Elective</i>	3		
	JUMLAH/ TOTAL	13		

STRUKTUR KURIKULUM/ CURRICULUM STRUCTURE

Nama Program : **Bac. Sains (Kepujian) Mikrobiologi/ Bachelor of Science (Honours) Microbiology**
Jumlah Kredit Bergraduat : **127 Jam Kredit/ Credit Hours**
Tempoh Pengajian : **8 Semester/ Semesters (4 Tahun/ Years)**

1. Kursus Universiti/ University Courses (23 kredit / credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
SKP2101	Kenegaraan Malaysia/ <i>Malaysian Nationhood</i>	3	3	0
BBI2423	<i>Academic Interaction and Presentation</i>	3	2	1
BBI2424	<i>Academic Writing</i>	3	2	1
PRT2008	Pertanian dan Manusia/ <i>Agriculture and Man</i>	2	2	0
MGM3180	Asas Keusahawanan/ <i>Basic Entrepreneurship</i>	3	2	1
SSK3000	Teknologi Maklumat dan Penggunaannya/ <i>Information Technology and Its Applications</i>	3	2	1
SKP2203	Tamadun Islam dan Tamadun Asia/ <i>Asian and Islamic Civilizations</i>	2	2	0
SKP2204	Hubungan Etnik/ <i>Ethnic Relation</i>	2	2	0
	Kokurikulum/ <i>Co-curriculum</i>	2	0	2

2. Kursus Teras/ Core Courses (72 kredit/ credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3101	Biomolekul/ <i>Biomolecules</i>	4	4	0
CHM3010	Kimia Fizik dan Tak Organik/ <i>Physical and Inorganic Chemistry</i>	4	3	1
CHM3201	Kimia Organik I/ <i>Organic Chemistry I</i>	4	3	1
BMY3101	Mikrobiologi I/ <i>Microbiology I</i>	4	4	0
BMY3102	Mikrobiologi II/ <i>Microbiology II</i>	4	4	0
BMY3103	Fisiologi Mikrob/ <i>Microbial Physiology</i>	3	3	0
BMY3201	Amali Mikrobiologi I/ <i>Practicals in Microbiology I</i>	2	0	2
BMY3202	Amali Mikrobiologi II/ <i>Practicals in Microbiology II</i>	3	0	3
BMY3203	Amali Mikrobiologi III/ <i>Practicals in Microbiology III</i>	3	0	3
BMY4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BMY4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BM 4304	Imunologi/ <i>Immunology</i>	3	3	0
BMY4302	Virologi/ <i>Virology</i>	3	3	0
BMY4303	Mikologi/ <i>Mycology</i>	3	3	0
BMY4308	Genetik Mikrob/ <i>Microbial Genetics</i>	3	3	0
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1

BCH3100	Pengiraan Asas dalam Biokimia/ <i>Basic Calculations in Biochemistry</i>	2	1	1
BCH3102	Enzimologi/ <i>Enzymology</i>	4	3	1
BMY4992	Topik Terkini Mikrobiologi/ <i>Current Topics in Microbiology</i>	2	0	2
BMY4901	Latihan industri/ <i>Industrial Training</i>	6	0	6
BMY4301	Bakteriologi/ <i>Bacteriology</i>	3	3	0

3. Kursus Elektif/ *Elective Course* (32 kredit/ *credits*)

KOD KURSUS/ <i>COURSE CODE</i>	NAMA KURSUS/ <i>COURSE NAME</i>	Kr	K	A
Kursus Elektif Sains dan Teknologi/ <i>Science and Technology Elective Courses</i> (20 kredit)				
BMY4201	Teknik Khas dalam Mikrobiologi/ <i>Specialised Techniques in Microbiology</i>	3	0	3
BMY4305	Ekologi Mikro/ <i>Microbial Ecology</i>	3	3	0
BMY4306	Mikrobiologi Patogenik/ <i>Pathogenic Microbiology</i>	3	3	0
BMY4307	Fisiologi Kulat/ <i>Fungal Physiology</i>	3	3	0
BMY4309	Mikrobiologi Makanan Gunaan/ <i>Applied Food Microbiology</i>	3	3	0
BCH3103	Metabolisme Karbohidrat/ <i>Carbohydrate Metabolism</i>	3	3	0
BCH3104	Metabolisme Protein dan Asid Nukleik/ <i>Protein and Nucleic Acid Metabolism</i>	3	3	0
BCH3105	Metabolisme Lipid dan Membran/ <i>Lipid Metabolism and Membranes</i>	3	3	0
BCH3200	Instrumentasi dalam Biokimia/ <i>Instrumentation in Biochemistry</i>	3	1	2
BCH4303	Penggunaan Biokimia dalam Industri/ <i>Industrial Applications of Biochemistry</i>	3	3	0
BCH4301	Biokimia Tumbuhan/ <i>Plant Biochemistry</i>	3	3	0
BCH4302	Manipulasi Genetik Tumbuhan/ <i>Plant Genetic Manipulation</i>	3	2	1
BCH4307	Biokimia Alam Sekitar/ <i>Environmental Biochemistry</i>	3	3	0
BCH4304	Biokimia Makanan/ <i>Food Biochemistry</i>	3	3	0
BCH4305	Biokimia Pemakanan/ <i>Nutritional Biochemistry</i>	3	3	0
BTC3201	Teknologi Fermentasi/ <i>Fermentation Technology</i>	4	3	1
BTC3401	Pengurusan dan Penggunaan Sisa/ <i>Waste Management and Utilisation</i>	2	2	0
BTC3002	Komersialisasi dan Isu Semasa Bioteknologi/ <i>Commercialisation and Current Issues in Biotechnology</i>	2	2	0
BTC4204	Mikrobiologi Industri/ <i>Industrial Microbiology</i>	4	3	1
BSM4601	Kejuruteraan Protein/ <i>Protein Engineering</i>	4	3	1
BSM3104	Prinsip Kultur Sel dan Tisu/ <i>Principles of Cell and Tissue Culture</i>	3	2	1
BSM4301	Bioinformatik/ <i>Bioinformatics</i>	3	2	1

BSM3202	Kejuruteraan Genetik/ <i>Genetic Engineering</i>	4	3	1
Kursus Elektif Pengurusan Dan Kemanusiaan / <i>Management and Humanities Elective Course</i> (6 kredit/credits)				
ACT2112	Perakaunan Pengenalan/ <i>Introductory Accounting</i>	4	3	1
ACT2131	Perakaunan Kos dan Pengurusan/ <i>Introductory Accounting</i>	3	3	0
ACT3211	Pengurusan Kewangan/ <i>Financial Management</i>	3	3	0
MGM3101	Prinsip Pengurusan/ <i>Principles of Management</i>	3	3	0
MGM3113	Gelagat Organisasi/ <i>Organizational Behavior</i>	3	3	0
MGM3211	Prinsip Pemasaran/ <i>Principles of Marketing</i>	3	3	0
MGM4174	Pengurusan Perkhidmatan/ <i>Services Management</i>	3	3	0
MGM4184	Pengurusan Perniagaan Kecil/ <i>Small Business Management</i>	3	3	0
Kursus Elektif: Pelajar perlu mengambil 6 kredit kursus elektif di fakulti lain dengan kebenaran Jabatan/ <i>Elective Courses: Student are required to take 6 credits of elective course from other faculties with permission from the department</i>				

Nota/ Notes : Kr = Jam Kredit/ *Credit Hour*, K = Kredit/ *Credit*, A = Amali/ *Laboratory*, T = Tutorial

Nota / Notes :

1. Pelajar diwajibkan memilih 2 kredit daripada kursus kokurikulum yang ditawarkan oleh universiti / *It is compulsory for students to take 2 credits of co-curriculum courses offered by the university*
2. Pelajar perlu melengkapkan pakej keperluan bahasa inggeris seperti jadual di bawah :
(Butiran lanjut mengenai CEL dan LAX sila rujuk di muka surat belakang buku panduan ini)
Students need to complete the english package as the table below : For more details on CEL and LAX please refer to the back/last page of this book.

MUET Band	Graduation Requirements for 4-year programmes
1 & 2	3 BBI + 3 CEL + 24 LAX points
3 & 4	2 BBI + 2 CEL + 36 LAX points
5 & 6	3 CEL + 36 LAX points

SKEMA PENGAJIAN/ STUDY SCHEME

TAHUN 1/ 1ST YEAR

SEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BBI2423	<i>Academic Interaction and Presentation</i>	3	2	1
SKP2101	<i>Kenegaraan Malaysia/ Malaysian Nationhood</i>	3	3	0
BCH3100	<i>Pengiraan Asas dalam Biokimia/ Basic Calculations in Biochemistry</i>	2	1	1
CHM3201	<i>Kimia Organik I/ Organic Chemistry I</i>	4	3	1
BMY3101	<i>Mikrobiologi I/ Microbiology I</i>	4	4	0
	<i>Kokurikulum/ Co-curriculum</i>	1	0	1
JUMLAH/ TOTAL		17	13	4

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BBI2424	<i>Academic Writing</i>	3	2	1
SKP2203	<i>Tamadun Islam dan Tamadun Asia/ Asian and Islamic Civilizations</i>	2	2	0
BCH3101	<i>Biomolekul/ Biomolecules</i>	4	4	0
BMY3102	<i>Mikrobiologi II/ Microbiology II</i>	4	4	0
BMY3201	<i>Amali Mikrobiologi I/ Practicals in Microbiology I</i>	2	0	2
	<i>Kokurikulum/ Co-curriculum</i>	1	0	1
JUMLAH/ TOTAL		16	12	4

TAHUN 2/ 2ND YEAR

SEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
SSK3000	<i>Teknologi Maklumat dan Penggunaannya/ Information Technology And Its Applications</i>	3	2	1
SKP2204	<i>Hubungan Etnik/ Ethnic Relation</i>	2	2	0
CHM3010	<i>Kimia Fizik dan Tak Organik/ Physical and Inorganic Chemistry</i>	4	3	1
BMY3202	<i>Amali Mikrobiologi II/ Practicals in Microbiology II</i>	3	0	3
BMY3103	<i>Fisiologi Mikrob/ Microbial Physiology</i>	3	3	0
JUMLAH/ TOTAL		15	10	5

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
PRT2008	Pertanian dan Manusia/ <i>Agriculture and Man</i>	2	2	0
BMY3203	Amali Mikrobiologi III/ <i>Practicals in Microbiology III</i>	3	0	3
BCH3102	Enzimologi/ <i>Enzymology</i>	4	3	1
BMY4301	Bakteriologi/ <i>Bacteriology</i>	3	3	0
	Elektif/ <i>Elective</i>	6		
	JUMLAH/ TOTAL	18		

TAHUN 3/ 3RD YEAR

SEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
MGM3180	Asas Keusahawanan/ <i>Basic Entrepreneurship</i>	3	2	1
BMY4302	Virologi/ <i>Virology</i>	3	3	0
BMY4303	Mikologi/ <i>Mycology</i>	3	3	0
	Elektif/ <i>Elective</i>	9		
	JUMLAH/ TOTAL	18		

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BMY4304	Imunologi/ <i>Immunology</i>	3	3	0
BMY4308	Genetik Mikrobl/ <i>Microbial Genetics</i>	3	3	0
BMY4901	Latihan industri/ <i>Industrial Training</i>	6	0	6
	JUMLAH/ TOTAL	12	6	6

TAHUN 4/ 4TH YEAR

SEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BMY4999A	Projek ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1
BMY4992	Topik Terkini Mikrobiologi/ <i>Current Topics in Microbiology</i>	2	0	2
	Elektif/ <i>Elective</i>	6		
	JUMLAH/ TOTAL	16		

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BMY4999B	Projek ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
	Elektif/ Elective	11		
	JUMLAH/ TOTAL	15		

STRUKTUR KURIKULUM/CURRICULUM STRUCTURE

Nama Program : **Bachelor Sains (Kepujian) Bioteknologi/Bachelor of Science (Honours) Biotechnology**
Jumlah Kredit Bergraduat : **135 Jam Kredit/ Credits Hours**
Tempoh Pengajian : **8 Semester/Semesters (4 Tahun/ Years)**

1. Kursus Universiti/ University Courses (23 kredit/ credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BBI2423	<i>Academic Interaction and Presentation</i>	3	2	1
BBI2424	<i>Academic Writing</i>	3	2	1
PRT2008	Pertanian dan Manusia/ <i>Agriculture and Man</i>	2	2	0
MGM3180	Asas Keusahawanan/ <i>Basic Entrepreneurship</i>	3	2	1
SSK3000	Teknologi Maklumat dan Penggunaannya/ <i>Information Technology and Its Applications</i>	3	2	1
SKP2101	Kenegaraan Malaysia/ <i>Malaysian Nationhood</i>	3	3	0
SKP2203	Tamadun Islam dan Tamadun Asia/ <i>Asian and Islamic Civilizations</i>	2	2	0
SKP2204	Hubungan Etnik/ <i>Ethnic Relation</i>	2	2	0
	Kokurikulum/ <i>Co-curriculum</i>	2	0	2

2. Kursus Teras/ Core Courses (77 kredit/ credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
CHM3201	Kimia Organik I/ <i>Organic Chemistry I</i>	4	3	1
PHY2001	Fizik Am/ <i>General Physics</i>	4	3	1
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1
BCH3001	Biokimia Komprehensif I/ <i>Comprehensive Biochemistry 1</i>	3	3	0
BCH3002	Biokimia Komprehensif II/ <i>Comprehensive Biochemistry II</i>	4	3	1
BSM3103	Biologi Sel dan Molekul	4	3	1
BSM3202	Kejuruteraan Genetik/ <i>Genetic Engineering</i>	4	3	1
BMY3001	Mikrobiologi/ <i>Microbiology</i>	4	4	0
BMY3201	Amali Mikrobiologi I/ <i>Practicals in Microbiology I</i>	2	0	2
BTC3401	Pengurusan dan Penggunaan Sisa/ <i>Waste Management and Utilisation</i>	2	2	0
BSM3104	Prinsip Kultur Sel dan Tisu/ <i>Principles of Cell and Tissue Culture</i>	3	2	1
BS 4301	Bioinformatik/ <i>Bioinformatics</i>	3	2	1
BTC3002	Komersialisasi dan Isu Semasa Bioteknologi/ <i>Commercialisation and Current Issues in Biotechnology</i>	2	2	0

BTC3101	Teknologi Enzim/ <i>Enzyme Technology</i>	4	3	1
BTC3201	Teknologi Fermentasi/ <i>Fermentation Technology</i>	4	3	1
BTC3301	Kejuruteraan Bioproses/ <i>Bioprocess Engineering</i>	4	4	0
BTC3302	Biopemisahan dan Penulenan/ <i>Bioseparation and Purification</i>	4	3	1
BTC3303	Rekabentuk Bioproses dan Peningkatan Skala/ <i>Bioprocess Design and Scaling-Up</i>	3	2	1
BTC4991	Seminar/ <i>Seminar</i>	1	0	1
BTC4901	Latihan industri/ <i>Industrial Training</i>	6	0	6
BTC4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BTC4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4

3. Kursus Elektif/*Elective Course* (35 kredit/ *credits*)

KOD KURSUS/ <i>COURSE CODE</i>	NAMA KURSUS/ <i>COURSE NAME</i>	Kr	K	A
Kursus Elektif Sains dan Teknologi/ <i>Science and Technology Elective</i> (23 kredit)				
BTC4204	Mikrobiologi Industri/ <i>Industrial Microbiology</i>	4	3	1
BTC4203	Teknologi Fermentasi Lanjutan/ <i>Advanced Fermentation Technology</i>	4	3	1
BTC4103	Bioteknologi Makanan/ <i>Food Biotechnology</i>	4	3	1
BTC4102	Teknologi Enzim Lanjutan/ <i>Advanced Enzyme Technology</i>	4	3	1
BTC4304	Pengoptimuman dan Simulasi Bioproses/ <i>Optimisation and Simulation in Bioprocess</i>	4	3	1
BTC4402	Bioteknologi Alam Sekitar/ <i>Environmental Biotechnology</i>	4	3	1
BTC4403	Bioremediasi/ <i>Bioremediation</i>	4	3	1
BTC4404	Teknologi Rawatan Air Sisa/ <i>Wastewater Treatment Technology</i>	4	3	1
BTC4405	Teknologi Rawatan Sisa Pepejal/ <i>Solid Waste Treatment Technology</i>	4	3	1
BSM4201	Genetik Molekul Gunaan/ <i>Applied Molecular Genetics</i>	4	3	1
BSM4502	Biologi Sel dan Molekul Tumbuhan Gunaan/ <i>Applied Plant Molecular and Cell Biology</i>	4	3	1
BSM4501	Kultur Sel dan Tisu Tumbuhan Gunaan/ <i>Applied Plant Cell and Tissue Culture</i>	4	3	1
BSM4503	Biologi Molekul Perkembangan Tumbuhan/ <i>Molecular Biology of Plant Development</i>	4	4	0
BSM4601	Kejuruteraan Protein/ <i>Protein Engineering</i>	4	3	1
BTC3003	Instrumentasi dalam Penyelidikan Bioteknologi/ <i>Instrumentation in Biotechnology Research</i>	3	2	1
BTC3004	Penulisan Saintifik Dalam Bioteknologi/ <i>Scientific Writing in Biotechnology</i>	3	3	0
BTC3202	Fermentasi Fasa Pepejal/ <i>Solid State Fermentation</i>	3	2	1
BTC3304	Rekabentuk Bioreaktor/ <i>Bioreactor Design</i>	3	2	1

BSM3203	Teknik Penyelidikan Dalam Biologi Molekul/ <i>Research Techniques in Molecular Biology</i>	3	2	1
BMV4302	Virologi/ <i>Virology</i>	3	3	0
BMV4305	Ekologi Mikrob/ <i>Microbial Ecology</i>	3	3	0
BMV4308	Genetik Mikrob/ <i>Microbial Genetics</i>	3	3	0
BCH4101	Biokimia Hormon/ <i>Biochemistry of Hormones</i>	3	3	0
BCH4301	Biokimia Tumbuhan/ <i>Plant Biochemistry</i>	3	3	0
BCH4307	Biokimia Alam Sekitar/ <i>Environmental Biochemistry</i>	3	3	0
BCH4304	Biokimia Makanan/ <i>Food Biochemistry</i>	3	3	0

Kursus Elektif Pengurusan dan Kemanusiaan/ *Management and Humanities Elective Courses*

Perlu ambil 12 Kredit sahaja. Perlu pilih minimum 6 kredit dari kursus di bawah dan selebihnya dari mana-mana kursus dengan kebenaran Jabatan kecuali kursus daripada Modul Keusahawanan Bioteknologi. *Students are required to take only 12 credits. A minimum of 6 credits should be selected from the list below and the remaining credits can be fulfilled by taking any of the courses permitted by the Department, except courses listed for Biotechnology Entrepreneurship Module.*

ACT2112	Perakaunan Pengenalan/ <i>Introductory Accounting</i>	4	3	1
ACT2131	Perakaunan Kos dan Pengurusan/ <i>Cost and Management Accounting</i>	3	3	0
ACT3211	Pengurusan Kewangan/ <i>Financial Management</i>	3	3	0
MGM3113	Gelagat Organisasi/ <i>Organizational Behavior</i>	3	3	0
MGM3211	Prinsip Pemasaran/ <i>Principles of Marketing</i>	3	3	0
MGM4174	Pengurusan Perkhidmatan/ <i>Services Management</i>	3	3	0
MGM4184	Pengurusan Perniagaan Kecil/ <i>Small Business Management</i>	3	3	0
MGM4183	Keusahawanan/ <i>Entrepreneurship **</i>	3	3	0
ECN3100	Prinsip Ekonomi/ <i>Principles of Economics</i>	3	3	0

Atau/ Or

Kursus Elektif Keusahawanan Bioteknologi/*Biotechnology Entrepreneurship Elective Courses* (12 kredit/ *credits*)

BTC3501	Keusahawanan Bioteknologi I/ <i>Biotechnology Entrepreneurship I</i>	3	2	1
BTC4501	Keusahawanan Bioteknologi II/ <i>Biotechnology Entrepreneurship II</i>	3	1	2
BTC4502	Keusahawanan Bioteknologi III/ <i>Biotechnology Entrepreneurship III</i>	3	1	2
BTC4503	Keusahawanan Bioteknologi IV/ <i>Biotechnology Entrepreneurship IV</i>	3	1	2

Nota / Notes :

1. Pelajar diwajibkan memilih 2 kredit daripada kursus kokurikulum yang ditawarkan oleh universiti / *It is compulsory for students to take 2 credits of co-curriculum courses offered by the university*
2. Pelajar perlu melengkapkan pakej keperluan bahasa inggeris seperti jadual di bawah :
(Butiran lanjut mengenai CEL dan LAX sila rujuk di muka surat belakang buku panduan ini)
Students need to complete the english package as the table below : For more details on CEL and LAX please refer to the back/last page of this book.

MUET Band	Graduation Requirements for 4-year programmes
1 & 2	3 BBI + 3 CEL + 24 LAX points
3 & 4	2 BBI + 2 CEL + 36 LAX points
5 & 6	3 CEL + 36 LAX points

SKEMA PENGAJIAN/ STUDY SCHEME

TAHUN 1/1ST YEAR

SEMESTER 1/1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1
BCH3001	Biokimia Komprehensif I/ <i>Comprehensive Biochemistry 1</i>	3	3	0
CHM3201	Kimia Organik I/ <i>Organic Chemistry I</i>	4	3	1
SKP2101	Kenegaraan Malaysia/ <i>Malaysian Nationhood</i>	3	3	0
BMY3001	Mikrobiologi/ <i>Microbiology</i>	4	4	0
JUMLAH/ TOTAL		18	16	2

SEMESTER 2/2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3002	Biokimia Komprehensif II/ <i>Comprehensive Biochemistry II</i>	4	3	1
BSM3103	Biologi Sel dan Molekul/ <i>Cell and Molecular Biology</i>	4	3	1
SKP2203	Tamadun Islam dan Tamadun Asia/ <i>Asian and Islamic Civilizations</i>	2	2	0
BMY3201	Amali Mikrobiologi I/ <i>Practicals in Microbiology I</i>	2	0	2
PHY2001	Fizik Am/ <i>General Physics</i>	4	3	1
	Kokurikulum/ <i>Co-curriculum</i>	1	0	1
JUMLAH/ TOTAL		17	11	6

TAHUN 2/2ND YEAR

SEMESTER 1/1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BSM3104	Prinsip Kultur Sel dan Tisu/ <i>Principles of Cell and Tissue Culture</i>	3	2	1
BTC3201	Teknologi Fermentasi/ <i>Fermentation Technology</i>	4	3	1
BTC3101	Teknologi Enzim/ <i>Enzyme Technology</i>	4	3	1
BBI2423	<i>Academic Interaction and Presentation</i>	3	2	1
BSM3202	Kejuruteraan Genetik/ <i>Genetic Engineering</i>	4	3	1
JUMLAH/ TOTAL		18	13	5

SEMESTER 2/2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
SKP2204	Hubungan Etnik/ <i>Ethnic Relation</i>	2	2	0
BTC3301	Kejuruteraan Bioproses/ <i>Bioprocess Engineering</i>	4	4	0
PRT2008	Pertanian dan Manusia/ <i>Agriculture and Man</i>	2	2	0
BBI2424	<i>Academic Writing</i>	3	2	1
MGM3180	Asas Keusahawanan/ <i>Basic Entrepreneurship</i>	3	2	1
SSK3000	Teknologi Maklumat dan Penggunaan/ <i>Information Technology and Its Applications</i>	3	2	1
	Kokurikulum/ <i>Co-Curriculum</i>	1	0	1
JUMLAH/ TOTAL		18	14	4

a. KURSUS ELEKTIF OPSYEN/MODUL : PENGURUSAN DAN KEMANUSIAAN OPTION/ MODULE ELECTIVE COURSES: MANAGEMENT AND HUMANITIES

TAHUN 3/3RD YEAR

SEMESTER 1/1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BSM4301	Bioinformatik/ <i>Bioinformatics</i>	3	2	1
BTC3302	Biopemisahan dan Penulenan/ <i>Bioseparation and Purification</i>	4	3	1
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	4		
	Elektif (Pengurusan dan Kemanusiaan)/ <i>Elective (Management and Humanity)</i>	3		
	Elektif (Pengurusan dan Kemanusiaan)/ <i>Elective (Management and Humanity)</i>	3		
JUMLAH/ TOTAL		17		

SEMESTER 2/2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BTC4901	Latihan Industri/ <i>Industrial Training</i>	6	0	6
BTC3002	Komersialisasi dan Isu Semasa Bioteknologi/ <i>Commercialisation and Current Issues in Biotechnology</i>	2	2	0
BTC3303	Rekabentuk Bioproses dan Peningkatan Skala/ <i>Bioprocess Design and Scaling-Up</i>	3	2	1
BTC3401	Pengurusan dan Penggunaan Sisa/ <i>Waste Management and Utilisation</i>	2	2	0
JUMLAH/ TOTAL		13	6	7

TAHUN 4/ 4TH YEAR

SEMESTER 1/1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BTC4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	4		
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	4		
	Elektif (Pengurusan dan Kemanusiaan)/ <i>Elective (Management and Humanity)</i>	3		
	Elektif (Pengurusan dan Kemanusiaan)/ <i>Elective (Management and Humanity)</i>	3		
JUMLAH/ TOTAL		18		

SEMESTER 2/2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BTC4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BTC4991	Seminar/ <i>Seminar</i>	1	0	1
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	4		
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	4		
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	3		
JUMLAH/ TOTAL		16		

b. KURSUS ELEKTIF OPSYEN/MODUL : KEUSAHAWANAN BIOTEKNOLOGI

OPTION/ MODULE ELECTIVE COURSES: BIOTECHNOLOGY ENTREPRENEUSHIP

TAHUN 3/3RD YEAR

SEMESTER 1/1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BSM4301	Bioinformatik/ <i>Bioinformatics</i>	3	2	1
BTC3302	Biopemisahan dan Penulenan/ <i>Bioseparation and Purification</i>	4	3	1
BTC3501	Keusahawanan Bioteknologi I/ <i>Biotechnology Entrepreneurship I</i>	3	2	1
	Elektif (Sains dan Teknologi) / <i>Elective (Science and Technology)</i>	7		
JUMLAH/ TOTAL		17		

SEMESTER 2/2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BTC4901	Latihan industri/ <i>Industrial Training</i>	6	0	6
BTC3002	Komersilalisasi dan Isu Semasa Bioteknologi/ <i>Commercialisation and Current Issues in Biotechnology</i>	2	2	0
BTC3303	Rekabentuk Bioproses dan Peningkatan Skala/ <i>Bioprocess Design and Scaling-Up</i>	3	2	1
BTC3401	Pengurusan dan Penggunaan Sisa/ <i>Waste Management and Utilisation</i>	2	2	0
BTC4501	Keusahawanan Bioteknologi II/ <i>Biotechnology Entrepreneurship II</i>	3	2	1
JUMLAH/ TOTAL		16	8	8

TAHUN 4/4TH YEAR

SEMESTER 1/1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BTC4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BTC4502	Keusahawanan Bioteknologi III/ <i>Biotechnology Entrepreneurship III</i>	3	1	2
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	10		
JUMLAH/ TOTAL		17		

SEMESTER 2/2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BTC4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BTC4503	Keusahawanan Bioteknologi IV/ <i>Biotechnology Entrepreneurship IV</i>	3	1	2
BTC4991	Seminar/ <i>Seminar</i>	1	0	1
	Elektif (Sains dan Teknologi)/ <i>Elective (Science and Technology)</i>	6		
JUMLAH/ TOTAL		14		

STRUKTUR KURIKULUM/ CURRICULUM STRUCTURE

Nama Program : **Bachelor Sains (Kepujian) Biologi Sel dan Molekul/ Bachelor of Science (Honours) Cell And Molecular Biology**

Jumlah Kredit Bergraduat : **128 Jam Kredit/ Credit Hours**

Tempoh Pengajian : **8 Semester/ Semesters (4 Tahun/ Years)**

1. Kursus Universiti/ University Courses (23 kredit/ credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BBI2423	<i>Academic Interaction and Presentation</i>	3	2	1
BBI2424	<i>Academic Writing</i>	3	2	1
PRT2008	<i>Pertanian dan Manusia/ Agriculture and Man</i>	2	2	0
MGM3180	<i>Asas Keusahawanan/ Basic Entrepreneurship</i>	3	2	1
SSK3000	<i>Teknologi Maklumat dan Penggunaannya/ Information Technology And Its Applications</i>	3	2	1
SKP2101	<i>Kenegaraan Malaysia/ Malaysian Nationhood</i>	3	3	0
SKP2203	<i>Tamadun Islam dan Tamadun Asia/ Asian and Islamic Civilizations</i>	2	2	0
SKP2204	<i>Hubungan Etnik/ Ethnic Relation</i>	2	2	0
	<i>Kokurikulum/ Co-curriculum</i>	2	0	2

2. Kursus Teras/ Core Courses (73 kredit/ credits)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3001	<i>Biokimia Komprehensif I/ Comprehensive Biochemistry 1</i>	3	3	0
BCH3002	<i>Biokimia Komprehensif II/ Comprehensive Biochemistry II</i>	4	3	1
BMY3001	<i>Mikrobiologi/ Microbiology</i>	4	4	0
BMY3201	<i>Amali Mikrobiologi I/ Practicals in Microbiology I</i>	2	0	2
BSM3101	<i>Biologi Sel dan Perkembangan/ Cellular and Developmental Biology</i>	3	3	0
BSM3201	<i>Biologi Molekul/ Molecular Biology</i>	3	3	0
BSM3202	<i>Kejuruteraan Genetik/ Genetic Engineering</i>	4	3	1
BSM3203	<i>Teknik Penyelidikan Dalam Biologi Molekul/ Research Techniques in Molecular Biology</i>	3	2	1
BSM3401	<i>Kultur Sel dan Tisu Haiwan/ Animal Cell and Tissue Culture</i>	3	2	1
BSM3402	<i>Imunologi Sel dan Molekul/ Cell and Molecular Immunology</i>	3	3	0
BSM3501	<i>Kultur Sel dan Tisu Tumbuhan/ Plant Cell and Tissue Culture</i>	3	2	1

BSM4201	Genetik Molekul Gunaan/ <i>Applied Molecular Genetics</i>	4	3	1
BSM4301	Bioinformatik/ <i>Bioinformatics</i>	3	2	1
BSM4901	Latihan Industri/ <i>Industrial Training</i>	6	0	6
BSM4991	Seminar/ <i>Seminar</i>	1	0	1
BSM4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BSM4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
BTC3001	Pengenalan Kepada Bioteknologi/ <i>Introduction to Biotechnology</i>	2	2	0
BTC3002	Komersilalisasi dan Isu Semasa Bioteknologi/ <i>Commercialisation and Current Issues in Biotechnology</i>	2	2	0
CHM3010	Kimia Fizik dan Tak Organik/ <i>Physical and Inorganic Chemistry</i>	4	3	1
CHM3201	Kimia Organik I/ <i>Organic Chemistry I</i>	4	3	1
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1

- i. Kursus Elektif/ *Elective Course*
Sains dan Teknologi/ *Science and technology* (20 kredit/ *credits*)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3102	Enzimologi/ <i>Enzymology</i>	4	3	1
BCH4301	Biokimia Tumbuhan/ <i>Plant Biochemistry</i>	3	3	0
BGY3101	Biodiversiti Mikroorganisme dan Tumbuhan/ <i>Microorganism and Plant Biodiversity</i>	4	3	1
BGY3501	Genetik/ <i>Genetics</i>	4	3	1
BMV4302	Virologi/ <i>Virology</i>	3	3	0
BSM3102	Mikroteknik/ <i>Microtechniques</i>	4	3	1
BSM4501	Kultur Sel dan Tisu Tumbuhan Gunaan/ <i>Applied Plant Cell and Tissue Culture</i>	4	3	1
BSM4502	Biologi Sel dan Molekul Tumbuhan Gunaan/ <i>Applied Plant Molecular and Cell Biology</i>	4	3	1
BSM4503	Biologi Molekul Perkembangan Tumbuhan/ <i>Molecular Biology of Plant Development</i>	4	4	0
BSM4601	Kejuruteraan Protein/ <i>Protein Engineering</i>	4	3	1
BSM4602	Proteomik/ <i>Proteomics</i>	4	3	1
BTC3201	Teknologi Fermentasi/ <i>Fermentation Technology</i>	4	3	1
BTC4204	Mikrobiologi Industri/ <i>Industrial Microbiology</i>	4	3	1
PLP3204	Patologi Tumbuhan Asas/ <i>Fundamentals of Plant Pathology</i>	3	2	1

- ii. Kursus Elektif/ *Elective Course*
Pengurusan dan Kemanusiaan/ *Management And Humanity* (9 kredit/ *credits*)

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
ACT2112	Perakaunan Pengenalan/ <i>Introductory Accounting</i>	4	3	1
ACT2131	Perakaunan Kos dan Pengurusan/ <i>Introductory Accounting</i>	3	3	0
ACT3211	Pengurusan Kewangan/ <i>Financial Management</i>	3	3	0
ECN3100	Prinsip Ekonomi/ <i>Principles Of Economics</i>	3	3	0
MGM3101	Prinsip Pengurusan/ <i>Principles of Management</i>	3	3	0
MGM3113	Gelagat Organisasi/ <i>Organizational Behavior</i>	3	3	0
MGM3211	Prinsip Pemasaran/ <i>Principles of Marketing</i>	3	3	0
MGM4174	Pengurusan Perkhidmatan/ <i>Services Management</i>	3	3	0
MGM4184	Pengurusan Perniagaan Kecil/ <i>Small Business Management</i>	3	3	0
MGM4187	Pengurusan Usahaniaga Baru/ <i>New Venture Management</i>	3	3	0
SKM2300	Pengenalan Kepada Multimedia/ <i>Introduction to Multimedia</i>	3	2	1

Pelajar perlu mengambil **3 kredit** kursus elektif di fakulti lain dengan kebenaran Jabatan/ *Student are required to take 3 credits of elective courses from other faculties with permission from the Department*

Nota / Notes :

1. Pelajar diwajibkan memilih 2 kredit daripada kursus kokurikulum yang ditawarkan oleh universiti / *It is compulsory for students to take 2 credits of co-curriculum courses offered by the university*
2. Pelajar perlu melengkapkan pakej keperluan bahasa inggeris seperti jadual di bawah :
(Butiran lanjut mengenai CEL dan LAX sila rujuk di muka surat belakang buku panduan ini)
Students need to complete the english package as the table below : For more details on CEL and LAX please refer to the back/last page of this book.

MUET Band	Graduation Requirements for 4-year programmes
1 & 2	3 BBI + 3 CEL + 24 LAX points
3 & 4	2 BBI + 2 CEL + 36 LAX points
5 & 6	3 CEL + 36 LAX points

SKEMA PENGAJIAN/ STUDY SCHEME

TAHUN 1/ 1ST YEAR

SEMESTER1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BBI2423	<i>Academic Interaction and Presentation</i>	3	2	1
CHM3010	<i>Kimia Fizik dan Tak Organik/ Physical and Inorganic Chemistry</i>	4	3	1
BSM3101	<i>Biologi Sel dan Perkembangan/ Cellular and Developmental Biology</i>	3	3	0
SSK3000	<i>Teknologi Maklumat dan Penggunaannya/ Information Technology and Its Applications</i>	3	2	1
SKP2101	<i>Kenegaraan Malaysia/ Malaysian Nationhood</i>	3	3	0
JUMLAH/ TOTAL		16	13	3

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BBI2424	<i>Academic Writing</i>	3	2	1
BCH3001	<i>Biokimia Komprehensif I/ Comprehensive Biochemistry 1</i>	3	3	0
BTC3001	<i>Pengenalan kepada Bioteknologi/ Introduction to Biotechnology</i>	2	2	0
CHM3201	<i>Kimia Organik I/ Organic Chemistry I</i>	4	3	1
BSM3201	<i>Biologi Molekul/ Molecular Biology</i>	3	3	0
PRT2008	<i>Pertanian dan Manusia/ Agriculture and Man</i>	2	2	0
JUMLAH/ TOTAL		17	15	2

TAHUN 2/ 2ND YEAR

SEMESTER1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BCH3002	<i>Biokimia Komprehensif II/ Comprehensive Biochemistry II</i>	4	3	1
BSM3501	<i>Kultur Sel dan Tisu Tumbuhan/ Plant Cell and Tissue Culture</i>	3	2	1
BSM4301	<i>Bioinformatik/ Bioinformatics</i>	3	2	1
BMY3001	<i>Mikrobiologi/ Microbiology</i>	4	4	0
SKP2203	<i>Tamadun Islam dan Tamadun Asia/ Asian and Islamic Civilizations</i>	2	2	0
	<i>Kokurikulum/ Co-Curriculum</i>	1	0	1
JUMLAH/ TOTAL		17	13	4

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BSM3202	Kejuruteraan Genetik/ <i>Genetic Engineering</i>	4	3	1
BSM3401	Kultur Sel dan Tisu Haiwan/ <i>Animal Cell and Tissue Culture</i>	3	2	1
BMY3201	Amali Mikrobiologi I/ <i>Practicals in Microbiology I</i>	2	0	2
SKP2204	Hubungan Etnik/ <i>Ethnic Relation</i>	2	2	0
	Elektif Pengurusan Dan Kemanusiaan/ <i>Management And Humanities Elective</i>	3		
	Elektif Sains Dan Teknologi/ <i>Science And Technology Elective</i>	4		
JUMLAH/ TOTAL		18		

TAHUN 3/ 3RD YEAR

SEMESTER1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BSM3203	Teknik Penyelidikan Dalam Biologi Molekul/ <i>Research Techniques in Molecular Biology</i>	3	2	1
BSM4201	Genetik Molekul Gunaan/ <i>Applied Molecular Genetics</i>	4	3	1
MGM3180	Asas Keusahawanan/ <i>Basic Entrepreneurship</i>	3	2	1
MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4	3	1
	Elektif Sains dan Teknologi/ <i>Science and Technology Elective</i>	4		
JUMLAH/ TOTAL		18		

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BTC3002	Komersialisasi dan Isu Semasa Bioteknologi/ <i>Commercialisation and Current Issues in Biotechnology</i>	2	2	0
BSM3402	Imunologi Sel dan Molekul/ <i>Cell and Molecular Immunology</i>	3	3	0
BSM4901	Latihan Industri/ <i>Industrial Training</i>	6	0	6
BSM4991	Seminar/ <i>Seminar</i>	1	0	1
JUMLAH/ TOTAL		12	5	7

TAHUN 4/ 4TH YEAR

SEMESTER 1/ 1ST SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BSM4999A	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
	Elektif Pengurusan dan Kemanusiaan/ <i>Management And Humanity Elective</i>	3		
	Elektif Sains dan Teknologi/ <i>Science and technology elective</i>	8		
	Kokurikulum/ <i>Co-Curriculum</i>	1		
	JUMLAH/ TOTAL	16		

SEMESTER 2/ 2ND SEMESTER

KOD KURSUS/ COURSE CODE	NAMA KURSUS/COURSE NAME	Kr	K	A
BSM4999B	Projek Ilmiah Tahun Akhir/ <i>Final Year Project</i>	4	0	4
	Elektif Pengurusan dan Kemanusiaan/ <i>Management And Humanity Elective</i>	3		
	Elektif Sains dan Teknologi/ <i>Science and technology elective</i>	4		
	Elektif/ <i>Elective</i>	3		
	JUMLAH/ TOTAL	14		

SINOPSIS KURSUS/ COURSE SYNOPSIS

Jabatan Biokimia/ Department of Biochemistry

BCH3001 Biokimia Komprehensif I/ *Comprehensive Biochemistry 1* 3(3+0)

Prasyarat : Tiada

Kursus merangkumi kelas utama biomolekul yang terdapat dalam sistem biologi. Proses biokimia yang mempengaruhi struktur dan fungsi biomolekul serta kaedah makmal untuk pengasingan dan analisis juga dibincangkan. Ciri fisiko-kimia dan fungsi air, asid amino dan protein, karbohidrat, nukleotida dan asid nukleik, asid lemak dan lipid, kofaktor dan vitamin, enzimologi dan membran juga diterangkan.

This course encompasses the major classes of biomolecules occurring in biological systems. Biochemical processes that influence their molecular structures and functions and laboratory methods for isolation and analysis are discussed. Physico-chemical properties and functions of water, amino acids and proteins, carbohydrates, nucleotides and nucleic acids, fatty acids and lipids, cofactors and vitamins, enzymology and membrane are explained.

BCH3002 Biokimia Komprehensif II/ *Comprehensive Biochemistry II* 4(3+1)

Prasyarat : BCH3001

Kursus merangkumi proses metabolik utama yang berlaku dalam sistem biologi termasuk bioenergetik, metabolisme biomolekul utama dan pengawalannya. Tapak jalan biosintesis dan degradasi asid amino dan protein, gula dan polisakarida, nukleotida dan asid nukleik, asid lemak dan lipid juga dibincangkan. Penekanan juga diberikan terhadap perhubungan di antara tapak jalan utama, peranan penting hormon dalam pengawalan metabolisme, mekanisme pemerangkapan tenaga dan kaedah makmal untuk mengkaji metabolisme.

This course encompasses the major metabolic processes occurring in biological systems including bioenergetics, metabolism of major biomolecules and their regulation. The pathways of synthesis and degradation of amino acids and proteins, sugars and polysaccharides, nucleotides and nucleic acids, fatty acids and lipids are also discussed. Emphasis is also given on the interrelationship between the major pathways, the vital role of hormones in metabolic regulation, the energy-trapping mechanisms and laboratory methods to study metabolism

BCH3100 Pengiraan Asas dalam Biokimia/ *Basic Calculations in Biochemistry* 2(1+1)

Prasyarat : Tiada

Kursus ini merangkumi pemahaman mengenai pengiraan dalam biokimia. Pengetahuan mengenai alatan asas dan pengiraan yang berkaitan dengan penggunaan alat seperti spektrofotometer dan pengempar dibincangkan. Statistik asas turut diterangkan.

This course encompasses the understanding of calculations in biochemistry. Knowledge of the basic equipments and calculations related to the use of equipments such as spectrophotometer and centrifuge are discussed. Basic statistics are also explained.

BCH3101 Biomolekul/ *Biomolecules* 4(4+0)

Prasyarat : Tiada

Kursus ini merangkumi pelbagai biomolekul, pengelasan serta peranannya dalam kehidupan. Biomolekul yang dibincangkan termasuk asid amino, protein, enzim dan protein pengawal, karbohidrat dan terbitannya, lipid dan terbitannya, asid nukleik, komponen dan jujukannya, serta vitamin dan koenzim.

This course encompasses the various biomolecules, their classification and roles in life. The biomolecules discussed include amino acids, proteins, enzymes and regulatory proteins, carbohydrates and derivatives, lipid and derivatives, nucleic acids, their components and sequence, as well as vitamins and coenzymes.

BCH3102 Enzimologi/ *Enzymology*

4(3+1)

Prasyarat : BCH3101 atau setara

Kursus ini merangkumi ciri umum enzim. Struktur dan fungsi enzim, koenzim dan kofaktor, kinetik enzim dan faktor yang mempengaruhi keaktifan enzim dibincangkan. Tindak balas dwi-substrat, pengawalan aktiviti, jenis dan model pengawalan juga diterangkan.

This course encompasses the general characteristics of enzymes. The structure and function of enzyme, coenzymes and cofactors, enzyme kinetics and factors affecting enzyme activity are discussed. Bi-substrate reactions, control mechanisms and their types and models are also explained.

BCH3103 Metabolisme Karbohidrat/ *Carbohydrate Metabolism*

3(3+0)

Prasyarat : BCH3102

Kursus ini merangkumi metabolisme karbohidrat di dalam sel. Glikolisis, kitaran asid trikarboksilik dan rantai respirasi serta integrasi dan mekanisme pengawalan dibincangkan. Metabolisme glikogen, laluan pentosa monofosfat, glukoneogenesis dan fotosintesis juga diuraikan.

This course encompasses carbohydrate metabolism in cell. Glycolysis, tricarboxylic acid cycle and the respiratory chain as well as their integration and regulation mechanisms are discussed. Glycogen metabolism, pentose monophosphate pathway, gluconeogenesis and photosynthesis are also described.

BCH3104 Metabolisme Protein dan Asid Nukleik/ *Protein and Nucleic Acid Metabolism*

3(3+0)

Prasyarat : BCH3102

Kursus ini merangkumi metabolisme asid amino, protein, nukleotida dan asid nukleik. Pelbagai aspek katabolisme serta anabolisme protein dan asid nukleik yang melibatkan tindak balas umum dan fungsi metabolik biomolekul ini diuraikan. Proses biosintesis protein dan asid nukleik dan pengawalannya juga dibincangkan.

This course encompasses the metabolism of amino acids, protein, nucleotides and nucleic acids. Different aspects of protein and nucleic acid catabolism and anabolism that include the general reactions and metabolic functions of these biomolecules are described. Protein and nucleic acid biosynthetic processes and their regulations are also discussed.

BCH3105 Metabolisme Lipid dan Membran/ *Lipid Metabolism and Membranes*

3(3+0)

Prasyarat : BCH3102

Kursus ini merangkumi proses yang terlibat dalam metabolisme lipid dalam mikroorganisma, tumbuhan dan haiwan serta pengawalannya. Komponen dan organisasi membran, pusing ganti dan fungsi juga dibincangkan.

This course encompasses processes involved in the metabolism of lipids in microorganisms, plants and animals and their regulations. Components and organizations of membranes, their turnover and functions are also discussed.

BCH3200 Instrumentasi dalam Biokimia/ *Instrumentation in Biochemistry* 3(1+2)

Prasyarat : BCH3101 atau BCH3002

Kursus ini merangkumi konsep saintifik dan cara penggunaan peralatan dalam bidang biokimia. Contoh alat termasuk spektrofotometer, kromatografi cecair berprestasi tinggi (HPLC), kromatografi gas (GC), pembilang sintilasi cecair (LSC), getaran bermagnet nuklear (NMR), elektroforesis dan mikroskop.

This course encompasses the scientific concepts and the use of instruments in the field of biochemistry. Examples of instruments include spectrophotometer, high performance liquid chromatography (HPLC), gas chromatography (GC), liquid scintillation counter (LSC), nuclear magnetic resonance (NMR), electrophoresis and microscope.

BCH3201 Analisis Biomolekul/ *Analysis of Biomolecules* 2(1+1)

Prasyarat : BCH3102 atau BCH3002

Kursus ini merangkumi teknik pengekstrakan dan penulenan karbohidrat, lipid, protein, asid nukleik dan vitamin. Analisis sifat fizikal dan kimia, penentuan berat molekul dan kehomogenan juga dilakukan. Faktor yang mempengaruhi aktiviti, spesifisiti dan kestabilan biomolekul pilihan dikaji.

This course encompasses the extraction and purification techniques for carbohydrates, lipids, proteins, nucleic acids and vitamins. Analysis of physical and chemical properties, molecular weight and homogeneity determination are also carried out. Factors affecting the activity, specificity and stability of selected biomolecules are studied.

BCH3202 Praktikal Metabolisme/ *Practicals in Metabolism* 2(1+1)

Prasyarat : BCH3102 atau BCH3002

Kursus ini merangkumi teknik yang berkaitan dengan metabolisme biomolekul dalam sel dan organisma hidup. Teknik pengekstrakan metabolit dari sistem tindak balas dibincangkan. Kaedah pengesaian menggunakan spektroskopi dan penentuan metabolit menggunakan pelbagai jenis kromatografi dijalankan.

This course encompasses related techniques in the metabolism of biomolecules in the cell and living organisms. Techniques on metabolite extraction from reaction systems are discussed. Assay methods using spectroscopy and determination of metabolites using various types of chromatography, are conducted.

BCH4301 Biokimia Tumbuhan/ *Plant Biochemistry* 3(3+0)

Prasyarat : BCH3101 atau BCH3002

Kursus ini merangkumi pengelasan dan metabolisme sebatian karbohidrat, pengelasan lipid dan taburannya, metabolisme sebatian nitrogen, biosintesis dan peranan pigmen, hasil sekunder dan sebatian tumbesaran. Tapakjalan metabolik utama dan hubungkaitnya dengan proses metabolisme yang lain dibincangkan. Zat galian dan peranannya dalam pemakanan tumbuhan juga dijelaskan.

This course encompasses the classification and metabolism of carbohydrate compounds, classification of lipid and its distribution, metabolism of nitrogen compounds, biosynthesis and function of pigments, secondary products and growth substances. The major metabolic pathways and their relationship with other metabolic processes are discussed. Minerals and their roles in plant nutrition are also explained.

BCH4101	Biokimia Hormon/ <i>Biochemistry of Hormones</i>	3(3+0)
Prasyarat : BCH3105 atau BCH3002		
Kursus ini merangkumi pengkelasan, sifat kimia dan penghasilan hormon. Fungsi hormon dalam metabolisme sel, koordinasi sel, interaksi antara molekul dan kecacatan patofisiologi turut dibincangkan.		
<i>This course encompasses the classification, chemical properties and production of hormones. The function of hormones in cell metabolism, cell coordination, interactions among molecules and pathophysiological disorders are also discussed.</i>		
BCH4303	Penggunaan Biokimia dalam Industri/ <i>Industrial Applications of Biochemistry</i>	3(3+0)
Prasyarat : BCH3102		
Kursus ini merangkumi konsep dan pengetahuan dalam biokimia untuk penyelidikan dan aplikasi dalam industri biokimia tradisional dan moden. Aplikasi biokimia dalam pelbagai industri seperti penghasilan bahan farmaseutika, kimia, bahan makanan dan kit diagnostik dibincangkan. Kepentingan paten dan aspek keselamatan juga diuraikan.		
<i>This course encompasses concept and knowledge in biochemistry for research and application in traditional and modern biochemical industry. Application of biochemistry in various industries such as production of pharmaceuticals, chemicals, food ingredients and diagnostic kits are discussed. The importance of patent and safety aspects are also described.</i>		
BCH4302	Manipulasi Genetik Tumbuhan/ <i>Plant Genetic Manipulation</i>	3(2+1)
Prasyarat : BCH3002 atau BCH3102		
Kursus ini merangkumi teknik biologi molekul tumbuhan termasuk analisis enzim, asid nukleik, protein, kaedah transformasi gen dan biopenanda. Kaedah yang menggunakan peralatan dalam kejuruteraan genetik juga dibincangkan.		
<i>This course encompasses molecular biology techniques including enzymatic analysis, nucleic acids, protein, genetic transfer methods and biomarkers. Methods, which utilize instruments in genetic engineering, are also discussed.</i>		
BCH4305	Biokimia Pemakanan/ <i>Nutritional Biochemistry</i>	3(3+0)
Prasyarat : BCH3102 atau BCH3002		
Kursus ini merangkumi pemetakan dan komposisi kimia tubuh manusia dalam proses penghadaman, penyerapan, pengangkutan dan metabolisme nutrien. Sifat, peranan fisiologi dan metabolisme protein, vitamin dan mineral serta peranannya dalam tumbesaran sel dibincangkan. Penyesuaian pemakanan, pemakanan tak seimbang, penaksiran status pemakanan, penentuan keperluan nutrien dan piawaian pemakanan juga dibincangkan.		
<i>This course encompasses the compartmentation and chemical composition of the human body involved in processes of digestion, absorption, transportation and metabolism of nutrients. The characteristics, roles, physiological functions and metabolism of protein, vitamins and minerals in cellular growth are discussed. Nutritional adaptation, nutritional disorders, assessment of nutritional status, determination of nutrient requirements and dietary standards are also discussed.</i>		
BCH4304	Biokimia Makanan/ <i>Food Biochemistry</i>	3(3+0)
Prasyarat : BCH3102 atau BCH3002		
Kursus ini merangkumi ciri fisiko-kimia makanan dan komponen utamanya. Sifat kimia dan ketoksikan komponen makanan tak berkhasiat seperti bahan tambah makanan, perencat protease, hemaglutinin, sisa racun perosak dan glukosida sianogen dibincangkan. Kesan pemprosesan ke atas nilai pemakanan dan penggunaan enzim dalam teknologi makanan juga ditekankan.		

This course encompasses the physico-chemical properties of foods and their major components. The chemistry and toxicity of non-nutritive constituents of foods such as food additives, proteolytic enzyme inhibitors, hemagglutinin, pesticide residues and cyanogenic glucosides will be discussed. The effects of processing on the nutritional value of food and the use of enzymes in food technology are also emphasized.

BCH4307 Biokimia Alam Sekitar/ *Environmental Biochemistry* 3(3+0)

Prasyarat : BCH3102 atau BCH3002 atau BCH3000

Kursus ini merangkumi aspek am pencemaran, proses rawatan kumbahan, penguraian jisim organik dan adaptasi mekanisme molekul terhadap persekitaran lampau. Interaksi antara organisma sesama sendiri, dengan organisma lain serta dengan persekitaran juga dibincangkan. Penekanan diberikan kepada metabolisme, transformasi, bioakumulasi dan ketoksikan pencemar persekitaran seperti racun perosak, bifenil poliklorin dan logam berat.

This course encompasses general aspects of pollution, water treatment, decomposition of organic matter and the molecular mechanisms of adaptation to extreme environments. Interactions of organisms among themselves, with other organisms, and the environment are discussed. Emphasis is given on metabolism, transformation, bioaccumulation and toxicity of environmental pollutants such as polychlorinated biphenyl, pesticides and heavy metals.

BCH4306 Biokimia Tisu Haiwan/ *Biochemistry of Animal Tissues* 3(3+0)

Prasyarat : BCH3102 atau BCH3002

Kursus ini merangkumi prinsip dan proses biokimia di dalam pelbagai jenis tisu haiwan termasuk usus, hati, ginjal, otot, kulit, struktur tisu, tulang, darah dan kelenjar endokrin. Interaksi metabolisme di antara tisu juga dibincangkan.

This course encompasses the principles and biochemical processes in various animal tissues including the intestines, liver, kidney, muscle, skin, structural tissues, bone, blood and the endocrine glands. Metabolic interactions among the tissues are also discussed.

BCH4901 Latihan Industri/ *Industrial Training* 6(0+6)

Prasyarat : BCH3202

Kursus ini meliputi latihan industri selama 12 minggu di agensi kerajaan atau beberapa syarikat atau kilang industri yang terpilih. Latihan dikendalikan bersama oleh penyelaras dan seorang penyelia atau pengurus dari agensi atau syarikat atau kilang tersebut.

This course covers an industrial training for a period of 12 weeks at various selected government agencies, companies or factories. The training is organized jointly by the coordinator and supervisor or the manager from the related agencies, company or factory.

BCH4992 Topik Terkini Biokimia/ *Current Topics in Biochemistry* 2(0+2)

Prasyarat : BCH3105

Kursus ini merangkumi sorotan literatur ke atas topik terkini dalam biokimia seperti farmakologi, biokimia struktur dan proteomik. Sorotan ke atas topik terpilih dibentangkan dalam dua seminar.

This course encompasses reviews on current topics in biochemistry such as pharmacology, structural biochemistry and proteomics. The review on the selected topics are presented in two seminars.

BCH4999 Projek Ilmiah Tahun Akhir/ *Final Year Project* 8(0 + 8)

Prasyarat : BCH3105

Kursus ini merangkumi pelaksanaan penyelidikan dan teknik penulisan saintifik dalam penyelidikan. Penekanan diberikan kepada pendekatan saintifik untuk menjana data secara sistematik melalui rekabentuk eksperimen, kaedah pengumpulan dan analisis serta tafsiran data.

This course encompasses research activities and scientific writing techniques in a research project. Emphasis is on the scientific approach in data generation systematical through experimental design, data collection, analysis and interpretation.

Jabatan Mikrobiologi/ Department of Microbiology

BMY3001	Mikrobiologi/ <i>Microbiology</i>	4(4+0)
Prasyarat : Tiada		
Kursus ini merangkumi beberapa aspek mikrobiologi asas termasuk organisasi, struktur, pengkulturan dan metabolisme mikroorganisma, mikroskopi, sistematik dan ekologi mikrob. Tatanama, taksonomi, pengkelasan dan pengenalpastian pelbagai jenis mikroorganisma dalam sistematik mikrob dibincangkan. Prinsip asas ekologi mikrob, kumpulan mikrob dan struktur komunitinya, pelbagai habitat, interaksi populasi, pengiraan mikrob dan kitaran biokimia dihuraiakan.		
<i>This course encompasses several aspects of basic microbiology including the organization, structure, cultivation and metabolism of microorganism, microscopy, microbial systematics and ecology. Nomenclature, taxonomy, classification and identification of various microorganisms in microbial systematics are discussed. Basic principles in microbial ecology, microbial groups and community structures and various habitats, population interactions, microbial quantification and biochemical cycling are described.</i>		
BMY3101	Mikrobiologi I/ <i>Microbiology I</i>	4(4+0)
Prasyarat : Tiada		
Kursus ini merangkumi beberapa aspek mikrobiologi asas termasuk organisasi dan struktur sel prokariot dan eukariot, pensterilan dan teknik disinfektan. Teknik pengkulturan, pemencilan dan mikroskopi dihuraiakan. Pemakanan, metabolisme dan genetik mikrob dibincangkan.		
<i>This course encompasses several aspects of basic microbiology including the organization, prokaryote and eukaryotic cell structures, sterilization and disinfection techniques. Techniques for cultivation, isolation and microscopy are described. Nutrition, metabolism and microbial genetics are discussed.</i>		
BMY3102	Mikrobiologi II/ <i>Microbiology II</i>	4(4+0)
Prasyarat : BMY3101		
Kursus ini merangkumi sistematik dan ekologi mikrob serta pengenalan kepada imunologi. Tatanama, taksonomi, pengkelasan dan pengenalpastian pelbagai jenis mikroorganisma dalam sistematik mikrob dibincangkan. Prinsip asas ekologi mikrob, kumpulan mikrob dan struktur komunitinya, pelbagai habitat, interaksi populasi, pengiraan mikrob dan kitaran biokimia dihuraiakan.		
<i>This course encompasses microbial systematics and ecology, and introductory immunology. In microbial systematics, nomenclature, taxonomy, classification and identification of various microorganisms are discussed. Basic principles in microbial ecology, microbial groups and community structures and various habitats, population interactions, microbial quantification and biochemical cycling are described.</i>		
BMY3103	Fisiologi Mikrob/ <i>Microbial Physiology</i>	3(3+0)
Prasyarat : BMY3101 atau BMY3001		
Kursus ini merangkumi struktur dan aktiviti metabolik mikroorganisma. Metabolisme karbohidrat, lipid, protein dan asid nukleik serta tindak balas penjanaan tenaga dan fotosintesis dibincangkan. Ekspresi gen dan operon dihuraiakan.		
<i>This course encompasses structure and metabolic activities of microorganisms. Carbohydrate, lipid, protein and nucleic acid metabolism and reactions involved in energy production and photosynthesis are discussed. Gene expression and operons are described.</i>		

BMY3201 Amali Mikrobiologi I/ *Practicals in Microbiology I* 2(0+2)

Prasyarat : BMY3101 atau BMY3001

Kursus ini merangkumi teknik asas dalam mikrobiologi termasuk pembiakan dan pertumbuhan kultur tulen, pewarnaan, pemerhatian mikroskopik, pensterilan serta teknik aseptik. Teknik dalam taksonomi dan enumerasi mikroorganisma juga dibincangkan.

This course encompasses basic techniques in microbiology including cultivation and growth of pure cultures, staining, microscopic observation, sterilization and aseptic techniques. Techniques in microbial taxonomy and enumeration are also discussed.

BMY3202 Amali Mikrobiologi II/ *Practicals in Microbiology II* 3(0+3)

Prasyarat : BMY3201

Kursus ini merangkumi teknik asas dalam mikrobiologi termasuk pembiakan dan pertumbuhan kultur tulen, pewarnaan, pemerhatian mikroskopik, pensterilan serta teknik aseptik. Teknik dalam taksonomi dan enumerasi mikroorganisma juga dibincangkan.

This course encompasses basic techniques in microbiology including cultivation and growth of pure cultures, staining, microscopic observation, sterilization and aseptic techniques. Techniques in microbial taxonomy and enumeration are also discussed.

BMY3203 Amali Mikrobiologi III/ *Practicals in Microbiology III* 3(0+3)

Prasyarat : BMY3202

Kursus ini merangkumi ujian asas biokimia untuk pengenalpastian mikroorganisma dari tanah, air dan makanan. Penekanan diberikan kepada fermentasi karbohidrat, hidrolisis lipid dan protein. Pelbagai teknik enumerasi mikroorganisma dijalankan.

This course encompasses basic biochemical tests for identification of microorganisms from soil, water and food. Emphasis is given on carbohydrate fermentation, lipid and protein hydrolysis. Various techniques on enumeration of microorganism are conducted.

BMY4304 Imunologi/ *Immunology* 3(3+0)

Prasyarat : BMY3102 atau BMY3001

Kursus ini merangkumi pelbagai konsep imunologi termasuk keimunan humoral dan sel, molekul yang terlibat dalam keimunan, hipersensitiviti, autoimuniti, kekurangan imun, toleransi imun dan imunologi transplantasi. Sistem kawalan imun dan peranan mereka dalam penyakit dibincangkan. Kaedah imunologi yang biasa digunakan di dalam makmal klinikal dan penyelidikan serta perkembangan terkini dalam ilmu imunologi diuraikan.

This course encompasses several concepts in immunology which include humoral and cellular immune responses, molecules involved in immunity, hypersensitivity, autoimmunity, immunodeficiency, immunotolerance, tumor and transplantation immunology. Control of these systems and their roles in diseases are discussed. Immunological methods which are commonly used in both clinical and research laboratories as well as the recent developments in immunology are described.

BMY4302 Virologi/ *Virology* 3(3+0)

Prasyarat : BMY3102 atau BMY3001

Kursus ini merangkumi ciri virus dan kaedah yang digunakan dalam virologi. Pengelasan dan taksonomi virus diperkenalkan. Viroid dan prion dibincangkan. Jangkitan virus dan kesannya ke atas perumah, epidemiologi dan kepatogenesis diuraikan.

This course encompasses various properties of viruses and the methods used in virology. Classification and taxonomy of viruses are introduced. Viroids and prions are discussed. Viral infection and its effects in hosts, epidemiology and pathogenicity are described.

BMY4307	Fisiologi Kulat/ <i>Fungal Physiology</i>	3(3+0)
Prasyarat : BMY3102 atau BMY3001		
Kursus ini merangkumi komposisi kimia dan struktur molekul sel kulat. Keperluan fizik dan kimia untuk pertumbuhan kulat, metabolisme primer dan sekunder, genetik dan perkembangan spora dibincangkan. Ketahanan dan mekanisme pertahanan terhadap racun kulat diuraikan. <i>This course encompasses the chemical composition and molecular structures of fungal cells. The physical and chemical requirements for fungal growth, primary and secondary metabolisms, genetics and spore development are discussed. Resistance and defensive mechanisms against fungicides are described.</i>		
BMY4308	Genetik Mikroba/ <i>Microbial Genetics</i>	3(3+0)
Prasyarat : BMY3102 atau BMY3001		
Kursus ini merangkumi pelbagai aspek genetik mikroba seperti replikasi DNA dan pengawalan pengekspresan gen, mekanisme pemindahan DNA dan rekombinasi genetik, unsur dan mekanisme transposisi. Teknik molekul dalam genetik mikroba dan gunaan dibincangkan. <i>This course encompasses various aspects of microbial genetics such as DNA replication and control of gene expression, mechanisms of DNA transfer and genetic recombination, elements and mechanisms of transposition. Molecular techniques in microbial and applied genetics are discussed.</i>		
BMY4309	Mikrobiologi Makanan Gunaan/ <i>Applied Food Microbiology</i>	3(3+0)
Prasyarat : BMY3102 atau BMY3001		
Kursus ini merangkumi topik semasa mikrobiologi makanan termasuk kemunculan patogen baru bawaan makanan, kaedah pantas pengenalpastian dan pencirian mikroorganisma makanan. Kesan komposisi makanan dan kaedah pengawetan ke atas pertumbuhan mikroorganisma makanan diterangkan. Aspek bioteknologi dan ciri kefungsi mikroorganisma makanan terpilih dibincangkan. <i>This course encompasses current topics in applied food microbiology which include new and emerging food-borne pathogens, rapid identification and characterization of food microorganisms. The effects of food properties and preservation techniques on microbial growth are described. Biotechnological aspects and functional properties of selected food microorganisms are discussed.</i>		
BMY4901	Latihan industri/ <i>Industrial Training</i>	6(0+6)
Prasyarat : Tiada		
Kursus ini meliputi latihan industri selama 12 minggu di agensi kerajaan atau beberapa syarikat atau kilang industri yang terpilih. Latihan dikendalikan bersama oleh penyelaras dan seorang penyelia atau pengurus dari agensi atau syarikat atau kilang tersebut. <i>This course covers an industrial training for a period of 12 weeks at various selected government agencies, companies or factories. The training is organized jointly by the coordinator and supervisor or the manager from the related agencies, company or factory.</i>		
BMY4992	Topik Terkini Mikrobiologi/ <i>Current Topics in Microbiology</i>	2(0+2)
Prasyarat : BMY3202		
Kursus ini merangkumi sorotan literatur ke atas topik terkini dalam mikrobiologi seperti nanobioteknologi, biologi molekul, imunologi molekul dan metagenomik. Sorotan terhadap topik terpilih dibentangkan dalam dua seminar. <i>This course encompasses reviews on current topics in microbiology such as nanobiotechnology, biology molecule, molecular immunology and metagenomics. The reviews on the selected topics are presented in two seminars.</i>		

BMY4999 Projek ilmiah Tahun Akhir/ *Final Year Project*

8(0+8)

Prasyarat : BMY3203

Kursus ini merangkumi pelaksanaan penyelidikan dan teknik penulisan saintifik satu projek penyelidikan. Penekanan diberikan kepada pendekatan saintifik untuk menjana data secara sistematik melalui rekabentuk eksperimen yang sesuai, kaedah pengumpulan dan analisis serta tafsiran data.

This course encompasses research activities and scientific writing techniques in a research project. Emphasis is on the scientific approach in data generation through systematic experimental design, data collection, analysis and interpretation.

Jabatan Teknologi Bioproses/Department of Bioprocess Technology

BTC3001 Pengenalan Kepada Bioteknologi/*Introduction to Biotechnology* 2(2+0)

Prasyarat : Tiada

Kursus ini merangkumi konsep dan asas bioteknologi serta definisinya. Pelbagai bidang bioteknologi dari era dahulu hingga sekarang juga dibincangkan. Sumbangan dari bidang-bidang asas seperti biokimia, mikrobiologi, biologi molekul dan kejuruteraan kejuruteraan bioproses dalam pembangunan bioteknologi. Aplikasi bidang-bidang bioteknologi dalam industri, pertanian, perubatan dan alam sekitar.

This course covers the concept and basis of biotechnology and its definition. Different disciplines in biotechnology from the early beginning to modern era will be discussed. Contribution of basic disciplines such as biochemistry, microbiology, molecular biology and biochemical engineering to the development of biotechnology. Application of different biotechnology disciplines in industry, agriculture, medicine and the environment.

BTC3002 Komersialisasi dan Isu Semasa Bioteknologi/
Commercialisation and Current Issues in Biotechnology 2(2+0)

Prasyarat : BMY3001 atau BMY3101

Kursus ini merangkumi isu dan masalah yang perlu diambil kira dalam memperkembangkan produk daripada skala makmal ke pasaran komersil. Pelbagai faktor yang mempengaruhi pemilihan projek penyelidikan untuk tujuan mengembangkan produk dalam pasaran juga ditekankan. Seterusnya kajian kes yang menggambarkan kejayaan dan kegagalan sesuatu produk yang dihasilkan dari pelbagai bidang bioteknologi turut diperkenalkan.

This course covers the issues and problems which need to be considered in the product development from laboratory scale to commercial marketplace. Numerous factors affecting the choice of research project for development into a commercial product were also emphasize. Furthermore specific case studies that reflects the success and failure of certain products in various fields of biotechnology are also introduced.

BTC3003 Instrumentasi dalam Penyelidikan Bioteknologi/
Instrumentation in Biotechnology Research 3(2+ 1)

Prasyarat : BCH3001

Kursus ini merangkumi prinsip operasi, ciri dan kaedah penggunaan instrumentasi dalam penyelidikan bioteknologi. Asas penjujukan protein dan DNA serta analisis ekspresi gen juga dibincangkan.

This course encompasses the operation principles, characteristics and methods of analytical instrumentations in biotechnology research. Principles of DNA and protein sequencing as well as genes expression analysis are discussed.

BTC3004 Penulisan Saintifik dalam Bioteknologi/
Scientific Writing in Biotechnology 3(3+0)

Prasyarat : Tiada

Kursus ini merangkumi kaedah untuk mencari dan mengumpul maklumat mengenai penyelidikan dalam bidang bioteknologi dan juga pelbagai format penulisan saintifik untuk jurnal, buku, poster, majalah, monograf dan akhbar. Beberapa manuskrip terpilih juga dibincangkan.

This course encompasses methods to search and gather information related to research in biotechnology field and also the different scientific writing formats for journal, book, poster, magazine, monograph and newspaper. Several selected manuscripts are also discussed.

BTC3101	Teknologi Enzim/ <i>Enzyme Technology</i>	4(3+1)
<p>Prasyarat : Tiada</p> <p>Kursus ini merangkumi aspek penghasilan, penulenan dan penggunaan pelbagai jenis enzim industri. Aplikasi serta kelebihan enzim dan sel tersekatgerak juga dibincangkan.</p> <p><i>This course encompasses various aspects of production, purification and application of various industrial enzymes. the application and advantages of immobilised enzyme and cells are also discussed.</i></p>		
BTC3401	Pengurusan dan Penggunaan Sisa/ <i>Waste Management and Utilisation</i>	2(2+0)
<p>Prasyarat : Tiada</p> <p>Kursus ini merangkumi perincian mengenai sumber, jenis, ciri dan komposisi sisa seterusnya rawatan dan pengendalian sisa. Kajian kes spesifik seperti perbandingan kaedah pengurusan sisa di Malaysia dan di negara-negara lain juga dibincangkan.</p> <p><i>This course covers the details on the sources, types, properties and composition of waste and also the wastes handling and treatment. Specific case studies such as comparison of waste management methods in Malaysia and other countries were also discussed.</i></p>		
BTC3201	Teknologi Fermentasi/ <i>Fermentation Technology</i>	4(3+1)
<p>Prasyarat : BMY3001 atau BMY3101</p> <p>Kursus ini merangkumi pelbagai aspek penting di dalam teknologi fermentasi yang melibatkan langkah-langkah penting sebelum dan semasa proses fermentasi serta juga analisis selepas proses fermentasi. Aplikasi teknologi fermentasi di dalam industri juga dibincangkan.</p> <p><i>The course covers important aspects in fermentation technology that describes the important steps involve before and during fermentation and also the analyses after fermentation process. The application of fermentation technology in industry are also discussed.</i></p>		
BTC3202	Fermentasi Fasa Pepejal/ <i>Solid State Fermentation</i>	3(2+1)
<p>Prasyarat : BTC3201</p> <p>Kursus ini merangkumi proses fermentasi yang melibatkan penggunaan bahan pepejal sebagai substrat. Pembangunan fermentasi fasa pepejal untuk penghasilan pelbagai produk termasuk bahan api, makanan, bahan kimia industri dan produk farmaseutikal menggunakan sisa agro-industri dibincangkan. Rekabentuk dan peningkatan skala bioreaktor fermentasi fasa pepejal diberi penekanan.</p> <p><i>This course encompasses the fermentation process utilizing solid materials as substrate. Development of solid-state fermentation for production of various products including fuel, foods, industrial chemicals and pharmaceutical products using agro-industrial wastes are discussed. The bioreactor design and scaling-up of solid state fermentation are emphasized.</i></p>		
BTC3301	Kejuruteraan Bioproses/ <i>Bioprocess Engineering</i>	4 (4+0)
<p>Prasyarat : BTC3201</p> <p>kursus ini merangkumi pengenalan kepada kejuruteraan bioproses dengan penekanan diberikan terhadap asas pengiraan kejuruteraan dan pengoptimuman proses. Pengenalan kepada alatan industri dan aspek kejuruteraan di dalam operasi bioreaktor untuk kultur tisu dan tindakbalas enzim dibincangkan.</p> <p><i>This course encompasses introduction to bioprocess engineering which emphasizes on fundamental engineering calculation and process optimisation. Overview on the industrial equipments and the engineering aspects in the bioreactor operation for cell cultures and enzyme reaction are discussed.</i></p>		

BTC3302	Biopemisahan dan Penulenan/Bioseparation and Purification	4 (3+1)
Prasyarat : BTC3201		
Kursus ini merangkumi pemrosesan hiliran untuk pemulihan semula dan penulenan produk fermentasi. Pelbagai teknik biopemisah dan penulenan dibincangkan bagi memahami sesuatu proses melalui carta alir, analisa inbangan jisim dan kos.		
<i>This course encompasses the downstream processing for the recovery and purification and fermentation product. Various bioseparation and purification techniques are discussed in order to understand the process using flow chart, mass balance analysis and costing.</i>		
BTC3303	Rekabentuk Bioproses dan Peningkatan Skala/Bioprocess Design and Scaling-Up	3 (2+1)
Prasyarat : BTC4301		
kursus ini merangkumi hhubungkan konsep pengkulturan sel, biopemisahan dan formulasi untuk penghasilan produk bioteknologi. Antara aspek yang dibincangkan termasuk konsep reka bentuk bioreaktor, pemrosesan hiliran, pengoptimuman bioproses, isu pengawalan dan kajian kes reka bentuk bioproses.		
<i>This course encompasses the inter-relationship of cell culture, bioseparation and formulation concept for production of biotechnology product. Aspects discussed include bioreactor design concept, downstream processing, bioprocess optimisation, regulatory issues and case studies of bioprocess design.</i>		
BTC3304	Rekabentuk Bioreaktor/Bioreactor Design	3 (2+1)
Prasyarat : BTC3201		
Kursus ini merangkumi pelbagai aspek rekaan bioreaktor yang digunakan dalam proses penghasilan produk bioteknologi menggunakan mikroorganisma, enzim, sel haiwan dan tumbuhan. Analisis keperluan spesifik sesuatu rekabentuk bioreaktor untuk sistem biologi yang berbeza juga diuraikan.		
<i>This course encompasses various aspects of bioreactor design used in the production of biotechnology products employing microorganisms, enzymes, animal and plant cells. Analysis on the specific requirement in each bioreactor design for different biological systems are explained.</i>		
BTC4102	Teknologi Enzim Lanjutan/Advanced Enzyme Technology	4 (3+1)
Prasyarat : BTC3101		
Kursus ini merangkumi aspek enzim dan sel tersekatgerak, kinetik dan aplikasi enzim tersekatgerak dalam industri. Aplikasi enzim lain termasuk termostabil, psikrofilik dan sintetik dibincangkan.		
<i>This course encompasses aspects on immobilised enzymes and cells, kinetic and application of immobilised enzyme in the industry. The applications of other enzymes including thermostable, psychrophilic and synthetic are discussed.</i>		
BTC4103	Bioteknologi Makanan/Food Biotechnology	4 (3+1)
Prasyarat : BCH3001 atau BCH3101		
Kursus ini merangkumi penggunaan biomangkin dalam industri dan ramuan makanan. Potensi teknologi kultur sel dalam penghasilan ramuan makanan; dan enzim sebagai agen analisis dalam sistem makanan, makanan transgenik dan ramuan makanan diuraikan. Undang-undang yang mengawal penggunaan biomangkin dalam makanan dibincangkan.		
<i>This course encompasses the applications of biological catalysts in the food industry and ingredient. The potential of cell culture technology in the production of food ingredients; and enzymes as analytical agents in food systems, transgenic foods and food ingredients are described. Rules and regulations in the use of biocatalysts in foods are discussed.</i>		

BTC4203 Teknologi Fermentasi Lanjutan/*Advanced Fermentation Technology* 4(3+1)

Prasyarat : BTC3201

Kursus ini merangkumi isu dan aspek terkini di dalam teknologi fermentasi termasuklah pengudaraan dan pengadukan, kaedah dan strategi kawalan proses, penggunaan biosensor, pemodelan dan simulasi komputer dan peningkatan skala. Ekonomi fermentasi dibincangkan.

This course encompasses recent issues and aspects in fermentation technology including aeration and mixing, methods and strategies of process control, the use of biosensors, modelling and computer simulation and scaling-up process. Fermentation economics are discussed.

BTC4204 Mikrobiologi Industri/*Industrial Microbiology* 4(3+1)
Prasyarat : BMY3001 atau BMY3101

Kursus ini merangkumi pelbagai aspek aplikasi dan industri mikrobiologi. Kepentingan, ciri-ciri, penambahbaikan mikrob, penghasilan dan aplikasi mikrob dalam industri juga dibincangkan.

This course covers various application aspects in industrial microbiology. The importance, characteristics, strain improvement, production and microbial application in industries are also discussed.

BTC4304 Pengoptimuman dan Simulasi Bioproses/*Optimisation and Simulation in Bioprocess* 4(3+1)

Prasyarat : BTC3201 dan BTC4301

Kursus ini merangkumi penggunaan teknik pengoptimuman dan simulasi dalam bioproses. Ini termasuk kaedah statistik dan pengoptimuman yang menekankan aplikasi program simulasi komputer untuk menganalisis data.

This course encompasses the use of optimisation methods and simulation in bioprocess. These include statistical and optimisation methods that emphasize on computer simulation programs for data analysis.

BTC4402 Bioteknologi Alam Sekitar/ *Environmental Biotechnology* 4(3+1)
Prasyarat : BTC3401

Kursus merangkumi penggunaan bioteknologi dalam mengawal dan memanipulasi pencemaran alam sekitar. Integrasi bioteknologi alam sekitar, isu terkini alam sekitar dan penyelesaian alternatif bagi pengawalan pencemaran alam sekitar dibincangkan.

This course encompasses the application of biotechnology in mitigating and manipulating the environmental pollutions. The integration in environmental biotechnology, current environmental issues and alternative solutions for maintaining the environmental pollution are discussed.

BTC4403 Bioremediasi/*Bioremediation* 4(3+1)
Prasyarat : BTC4402

Kursus ini merangkumi kaedah rawatan dan bioremediasi ke atas sisa toksik terutama terhadap tanah dan air bawah tanah yang tercemar. Potensi penggunaan mikroorganisma untuk pelbagai rawatan sisa toksik dan berbahaya dibincangkan. Proses yang diguna pakai di industri dirujuk untuk memperjelaskan kaedah dan konsep bioremediasi.

This course encompasses treatment methods and bioremediation of toxic waste especially in polluted soil and groundwater. The potential use of microorganisms in various treatments of toxic and hazardous wastes are discussed. Industrial processes are referred in order to clarify the method and concept of bioremediation.

BTC4404	Teknologi Rawatan Air Sisa/ <i>Wastewater Treatment Technology</i>	4(3+1)
Prasyarat : BTC3401		
Kursus ini merangkumi teknologi yang terlibat di dalam rawatan air sisa. Jenis rawatan dan perbandingan bagi setiap jenis kaedah rawatan air sisa, pembuangan dan penggunaan semula air sisa dibincangkan.		
<i>This course encompasses technologies involved in wastewater treatment. The types of treatment methods and comparison of each method, wastewater disposal and re-use are discussed.</i>		
BTC4405	Teknologi Rawatan Sisa Pepejal/ <i>Solid Waste Treatment Technology</i>	4(3+1)
Prasyarat : BTC3401		
Kursus ini merangkumi aspek pengurusan sisa pepejal dari perumahan dan buangan industri di kawasan tropika. Pencirian, cara rawatan, pengurangan sisa dan konsep kitar semula dibincangkan.		
<i>This course encompasses solid waste management aspects for domestic and industrial wastes in tropical areas. Characterisation, treatment methods, waste minimisation and recycling concept are discussed.</i>		
BTC4901	Latihan industri/ <i>Industrial Training</i>	6(0+6)
Prasyarat : Tiada		
Kursus ini meliputi latihan industri selama 12 minggu di agensi kerajaan atau beberapa syarikat atau kilang industri yang terpilih. Latihan dikendalikan bersama oleh penyelaras dan seorang penyelia atau pengurus dari agensi atau syarikat atau kilang tersebut.		
<i>This course covers an industrial training for a period of 12 weeks at various selected government agencies, companies or factories. The training is organized jointly by the coordinator and supervisor or the manager from the related agencies, company or factory.</i>		
BTC4991	Seminar/ <i>Seminar</i>	1(0+1)
Prasyarat : Tiada		
Kursus ini merangkumi penyediaan dan penyampaian seminar secara berkesan mengenai projek penyelidikan dalam bidang teknologi bioproses. Pendedahan kepada pelbagai teknik penyampaian seminar dicapai dengan menghadiri seminar tertentu di dalam kampus.		
<i>This course encompasses the effective preparation and delivery of seminar on research project in bioprocess technology. Exposure to different techniques of seminar presentation is achieved by attending selected seminar held in campus.</i>		

Jabatan Biologi Sel dan Molekul/ Department of Cell & Molecular Biology

BSM3101	Biologi Sel dan Perkembangan/ <i>Cellular and Developmental Biology</i>	3(3 + 0)
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Prasyarat : Tiada

Kursus ini merangkumi prinsip biologi dan membandingkan pelbagai jenis sel seperti prokariot, eukariot dan virus, dari segi fisiologi dan organisasi genom. Konsep kitaran sel, struktur dan fungsi pelbagai jenis sel dan organel dibandingkan. Teori endosimbiosis, struktur dan fungsi membran sel dan nukleus serta mekanisme pengangkutan molekul juga diterangkan. Proses perkembangan dan perbezaan sel eukariot dan isu terkini berkaitan biologi sel dan perkembangan dibincangkan.

This course encompasses the principles of biology and compares various cell types such as prokaryotes, eukaryotes and viruses in terms of physiology and genome organisation. Concept of the cell cycle, structure and function of various cell types and organelles are compared. Endosymbiosis theory, structure and function of sel and nuclear membrane and the mechanism of molecular transport are explained. Cellular development and differentiation of eukaryotic cell and current issues related current issues related to cellular and developmental biology are discussed.

BSM3102	Mikroteknik/ <i>Microtechniques</i>	4(3 + 1)
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Prasyarat : BSM3101 atau BSM3103

Kursus ini merangkumi prinsip dan kaedah asas dalam kajian histologi tumbuhan dan haiwan. Pengawetan tisu, penyusupan dan pembenaman parafin, pewarnaan histologi, penyediaan slaid, identifikasi sel dan tisu tumbuhan serta haiwan dibincangkan. Integrasi antara morfologi mikroskopi dengan fisiologi asas sel dan tisu diterangkan. Penekanan diberikan kepada cara penggunaan mikroskop cahaya dan teknik asas histologi.

This course encompasses the basic principles and methods of histological studies in plant and animal. Tissue fixation, infiltration and paraffin embedding, histological staining, slide preparation and identification of plant or animal cells and tissues are discussed. Integration of microscopic morphology with basic physiology of cells or tissues are explained. Emphasis is on the usage of light microscopy as well as histological techniques.

BSM3104	Prinsip Kultur Sel dan Tisu/ <i>Principles of Cell and Tissue Culture</i>	3(2+1)
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Prasyarat : Tiada

Kursus ini merangkumi prinsip dan prosedur asas kultur tisu tumbuhan dan haiwan. Keperluan asas untuk mewujudkan dan memelihara kultur sel di dalam makmal akan ditekankan. Ini termasuklah pelbagai kaedah seperti kultur embrio zigotik, kultur kalus dan organogenesis. Kestabilan genetik dan variasi somaklon akan dibincangkan. Kursus ini juga meliputi pelbagai konsep dan teknik dalam pengkulturan sel haiwan. Prinsip penghasilan antibodi monoklonal dan perbagai asai sitotoksik juga akan dibincangkan.

This course encompasses the principles and basic procedures of cell and tissue culture. The basic requirements for establishing and maintaining cell cultures in the laboratory will be emphasized. This includes various methods such as Zygotic embryo culture, callus culture and organogenesis. Genetic stability and somaclonal variation are discussed. This course also covers various concept and techniques in animal cell culture. Principles of monoclonal antibody production and various cytotoxic assays are also discussed.

BSM3201	Biologi Molekul/ <i>Molecular Biology</i>	3(3 + 0)
Prasyarat : Tiada		
Kursus ini merangkumi prinsip biologi molekul seperti struktur dan peranan DNA dan RNA sebagai bahan genetik, struktur kromosom dan pewarisan di luar kromosom. Elemen yang boleh ditransposisikan, replikasi DNA, transkripsi, translasi, mutasi, metilasi, pembaikan DNA dan hubungan antara proses tersebut dibincangkan. Pengawalaturan ekspresi gen di antara prokariot dan eukariot dibandingkan.		
<i>This course encompasses the principles of molecular biology such as the structure and role of DNA and RNA as genetic materials, structure of chromosome and extrachromosomal inheritance. Transposable elements, DNA replication, transcription, translation, mutation, methylation, DNA repair and relationship between all these processes are discussed. The regulations of gene expression in eukaryotes and prokaryotes are compared.</i>		
BSM3202	Kejuruteraan Genetik/ <i>Genetic Engineering</i>	4 (3+1)
Prasyarat : BSM3201 atau BSM3103 atau BCH3101		
Kursus ini merangkumi teknik asas untuk pengklonan dan manipulasi gen. Prosedur pengklonan, penyaringan dan pengenalpastian gen asing, vektor pengklonan, pembatasan vektor dan selitan DNA dan proses transformasi dibincangkan. Teknologi PCR dan penjujukan DNA juga diterangkan. Isu etika berkaitan dengan teknologi DNA rekombinan turut diberi penekanan. Penekanan juga diberikan kepada aspek praktikal bagi menguasai kemahiran asas dalam teknik DNA rekombinan.		
<i>This course encompasses the basic techniques for cloning and manipulation of genes. Procedures for cloning, screening and identification of heterologous genes, cloning vectors, restriction of vector and insertion of DNA and transformation process are discussed. PCR technology and DNA sequencing are also explained. Ethical issues in relation to recombinant DNA technology are emphasised. Emphasis is also given on the practical aspect in order to acquire basic skill in recombinant DNA techniques.</i>		
BSM3203	Teknik Penyelidikan Dalam Biologi Molekul/ <i>Research Techniques in Molecular Biology</i>	3 (2+1)
Prasyarat : BSM3201 atau BSM3103		
Kursus ini merangkumi teori dan penggunaan teknik dalam penyelidikan biologi molekul termasuk teknik pemencilan DNA genom (prokariot dan eukariot), penulenan DNA, penghibridan dan pembotan DNA, pelabelan prob, pemencilan dan elektroforesis RNA, tatasusunan mikro dan PCR masa-nyata. Teknik lanjutan untuk analisis DNA, RNA dan protein seperti cDNA-AFLP, SDS-PAGE, gel elektroforesis-2D dan translasi <i>in vitro</i> turut dibincangkan.		
<i>This course encompasses the theories and applications of techniques used in molecular-biological research including genomic DNA isolation (eukaryotes and prokaryotes), DNA purification, DNA blotting and hybridization, probes labelling, RNA isolation and electrophoresis, microarray and real-time PCR. Advance techniques in analysis of DNA, RNA and protein such as cDNA-AFLP, SDS-PAGE, 2D-gel electrophoresis and in-vitro translation are also discussed.</i>		
BSM3401	Kultur Sel dan Tisu Haiwan/ <i>Animal Cell and Tissue Culture</i>	3 (2+1)
Prasyarat : Tiada		
Kursus ini merangkumi sejarah perkembangan, organisasi dan keperluan makmal untuk pengkulturan sel dan tisu haiwan. Penekanan diberikan kepada pelbagai teknik pengkulturan sel dan tisu haiwan seperti sel ampaian dan sel melekat, serta penyediaan kultur tisu dan organ primer. Penggunaan prinsip dan teknik pengkulturan sel skala besar, penghasilan sel hibridoma dan pengkulturan sel stem hemopoitik diuraikan. Aplikasi teknik pengkulturan tisu haiwan dibincangkan		

This course encompasses the developmental history, organization and laboratory requirements for animal cell and tissue culture. Emphasis is given on various techniques of animal cell and tissue culture such as suspension and anchorage dependent cells, and preparation of primary tissue and organ culture. Application of the principles and techniques for large scale culture, generation of hybridoma cells and culture of hemopoietic stem cells are explained. Application of animal tissue culture techniques are discussed.

BSM3402	Imunologi Sel dan Molekul/ <i>Cell and Molecular Immunology</i>	3 (3+0)
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Prasyarat : BSM3401 dan BMY3001

Kursus ini merangkumi konsep penting dalam imunologi termasuk ciri asas tindakbalas imun, sel dan tisu dalam sistem imun serta mekanisme keimunan. Biologi limfosit T dan B termasuk perkembangan sel T dan B dari sel induk, pengaktifan dan pengawalan sel T dan B, antibodi dan antigen, molekul kompleks keserasian histo utama (MHC), imunologi transplantasi, hipersensitiviti dan autoimuniti dibincangkan.

This course encompasses the important concepts in immunology including basic properties of immune responses, cells and tissues in the immune system and the mechanism of immune responses. The biology of T and B lymphocytes including development of T and B cells from the progenitor cells, activation and regulation of T and B cells, antibody and antigen, and Major Histocompatibility Complex (MHC) molecule, transplantation immunology, hypersensitivity and autoimmunity are discussed.

BSM3501	Kultur Sel dan Tisu Tumbuhan/ <i>Plant Cell and Tissue Culture</i>	3 (2+1)
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Prasyarat : Tiada

Kursus ini merangkumi penghasilan kultur sel dan tisu tumbuhan, organisasi dan keperluan makmal bagi menjalankan teknik aseptik. Penekanan diberikan kepada cara penyediaan stok dan media, bukti totipotensi, kultur kalus, kultur sel ampaian, embriogenesis somatik, organogenesis, kultur anter/debunga dan kultur protoplas. Kestabilan genetik, variasi somaklon, rekabentuk eksperimen dan aplikasi teknik kultur sel serta tisu tumbuhan dalam industri berasaskan pertanian dibincangkan.

This course encompasses the development of plant cell and tissue culture, organization and laboratory requirements to carry out aseptic techniques. Emphasis is given to methods used for preparation of stocks and media, proof of totipotency, callus culture, suspension cell culture, somatic embryogenesis, organogenesis, anther/pollen and protoplast cultures. Genetic stability, somaclonal variation, experimental design and applications of plant cell and tissue culture techniques in agriculture-based industries are discussed.

BSM4201	Kultur Sel dan Tisu Tumbuhan/ <i>Plant Cell and Tissue Culture</i>	4 (3+1)
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Prasyarat : BSM3202

Kursus ini merangkumi peranan kejuruteraan genetik dalam pembangunan teknologi genetik molekul dan kegunaannya dalam bidang bioteknologi pertanian, perubatan, terapeutik dan industri. Pembangunan dan penggunaan protein rekombinan dalam sistem prokariot dan eukariot, peranan genomik fungsian ke arah pemahaman dan pengubahsuaian proses biologi di peringkat molekul dan aplikasi kejuruteraan genetik dalam pelbagai industri dibincangkan.

This course encompasses the role of genetic engineering in the development of molecular genetic technologies and their applications in agricultural, medical, therapeutics and industrial biotechnology. The development and use of recombinant proteins in eukaryotic and prokaryotic systems, the role of functional genomics in understanding and manipulating biological processes at the molecular level, and the applications of genetic engineering in various industries are discussed.

BSM4301 Bioinformatik/ *Bioinformatics* 3(2+1)

Prasyarat : BSM3201 atau BCH3101

Kursus ini merangkumi penelitian perisian komputer terkini dalam bioinformatik. Penekanan adalah kepada aspek teori dan praktik dalam analisis dan pengolahan jujukan asid nukleik dan protein, serta penggunaan perisian dalam analisis.

The course encompasses details on computer programs in bioinformatics. Emphasis is on the theory and practical aspects of analysis and manipulations of nucleic acid and amino acid sequences, and the use of softwares in the analysis.

BSM4501 Kultur Sel dan Tisu Tumbuhan Gunaan/ *Applied Plant Cell and Tissue Culture* 4(3+1)

Prasyarat : BSM3501

Kursus ini merangkumi konsep penting bagi pembiakan klon tumbuhan dalam pertanian, hortikultur dan perubatan. Kaedah bagi pengeluaran tumbuhan bebas dari patogen, variasi rintang penyakit dan tekanan serta kepentingannya dalam penghasilan varieti baru dibincangkan. Prinsip penyimpanan germplasma dan penghasilan metabolit sekunder serta potensi kejuruteraan genetik tumbuhan diterangkan.

This course encompasses essential concepts for clonal propagation of agricultural, horticultural and medicinal plants. Methods for production of pathogen-free plants, disease-resistant and stress-tolerant strains and the importance in the production of new varieties are discussed. The principles of germplasm storage, secondary metabolites and potential of genetic engineering in plants are described.

BSM4502 Biologi Sel dan Molekul Tumbuhan Gunaan/ *Applied Plant Molecular and Cell Biology* 4(3+1)

Prasyarat : BSM3201 dan BSM3202

Kursus ini merangkumi aspek manipulasi dan penganalisan genom tumbuhan. Kaedah biologi molekul dalam pembiakan tumbuhan termasuk teknik transformasi tumbuhan, pembinaan kaset pengekspresan, pembiakan tumbuhan bantuan penanda, analisis ciri multigenik, teknologi gen tata susunan mikro, RNAi dan teknik imunokimia diterangkan. Pelbagai isu berkaitan dengan produk terubahsuai secara genetik dibincangkan.

This course encompasses aspects of manipulation and analyses of plant genome. Applications of molecular biology techniques in plant breeding include plant transformation techniques, construction of expression cassette, marker-assisted breeding, analysis of multigenic traits, gene microarray technology, RNAi and immunocytochemistry techniques are explained. Various issues on genetically modified products are discussed.

BSM4503 Biologi Sel dan Molekul Tumbuhan Gunaan/ *Applied Plant Molecular and Cell Biology* 4(4+0)

Prasyarat : BSM3201 dan BSM3101

Kursus ini merangkumi prinsip asas biologi perkembangan tumbuhan. Aspek perkembangan sel dan organ tumbuhan seperti struktur dan fisiologi sel, proses perkembangan sel dan organ dibincangkan. Hubungkait di antara pengekspresan gen dengan fungsi struktur dan fisiologi tisu tumbuhan diterangkan.

This course encompasses the basic principles of plant developmental biology. Aspects of plant cell and organ development, such as cell structures and physiology, cell and organ developmental processes are discussed. The relationship of gene expression to structure and physiological functions of plant tissues is explained.

BSM4601 Kejuruteraan Protein/ *Protein Engineering* 4(3 + 1)

Prasyarat : BSM3202 dan BCH3001

Kursus ini merangkumi penggunaan teknik kimia dan genetik untuk mengubahsuaikan struktur protein bagi menghasilkan produk novel. Penekanan diberikan kepada teori penstabilan protein, teknik penulenan, analisis, penentuan struktur 3D dan teknik pengubahsuaian protein.

This course encompasses the use of genetic and chemical techniques to modify protein structure for a novel product. Emphasis is on the theories related to protein stabilization, purification techniques, analysis, 3D structure determination and protein modification techniques.

BSM4602 Proteomik/ *Proteomics* 4(3 + 1)

Prasyarat : BCH3002

Kursus ini merangkumi konsep, teknologi dan kegunaan proteomik. Dinamik dan kompleksiti proteom, pengubahsuaian dan kepelbagaian protein, ekspresi dan interaksi proteom, teknologi proteom dan penggunaannya, serta informatik protein diuraikan. Kegunaan proteomik dalam penyelidikan berasaskan bioteknologi dan perubatan dibincangkan.

This course encompasses the concepts, technologies and applications of proteomics. The dynamics and complexity of proteome, protein modification and diversity, proteome expression and interaction, proteome technologies and their applications, and protein informatics are described. Applications of proteomics in biotechnology and medical research are discussed.

BSM4901 Latihan Industri/ *Industrial Training* 6(0 + 6)

Prasyarat : BSM3101 dan BSM3202

Kursus ini meliputi latihan industri selama 12 minggu di agensi kerajaan atau beberapa syarikat atau kilang industri yang terpilih. Latihan dikendalikan bersama oleh penyelaras dan seorang penyelia atau pengurus dari agensi atau syarikat atau kilang tersebut.

This course covers an industrial training for a period of 12 weeks at various selected government agencies, companies or factories. The training is organized jointly by the coordinator and supervisor or the manager from the related agencies, company or factory.

BSM4991 Seminar/ *Seminar* 1(0+1)

Prasyarat : BSM3101 dan BSM3202

Kursus ini merangkumi penyediaan dan penyampaian seminar mengenai topik terkini dalam bidang biologi sel dan molekul. Pelajar perlu membuat sorotan literatur, menyusun dan membentangkan maklumat biologi sel dan molekul dalam satu seminar. Pelajar diwajibkan menghadiri seminar tertentu untuk mempelajari pelbagai teknik penyampaian seminar.

This course encompasses the preparation and delivery of seminars on current topics in cell and molecular biology. Each student is required to review the literature, organise and present information on cell and molecular biology in a seminar. It is compulsory for students to attend selected seminars to learn the different techniques of seminar presentation.

Prasyarat : BSM3101 dan BSM3202

Kursus ini merangkumi pelaksanaan kaedah penyelidikan dan teknik penulisan saintifik untuk suatu projek penyelidikan. Penekanan diberikan kepada pendekatan saintifik untuk menjana data secara sistematik melalui rekabentuk eksperimen yang sesuai, kaedah pengumpulan dan analisis data yang tepat, serta tafsiran data.

This course encompasses the implementation of research methodology and scientific writing techniques in a research project. Emphasis is on the scientific approach to systematic data generation through correct design of experiment, data collection and analysis and interpretation.

KURSUS TAWARAN FAKULTI LAIN

(Sila rujuk sinopsis pada fakulti berkenaan)

1. FAKULTI EKOLOGI

1.1	SKP2101	Kenegaraan Malaysia/ <i>Malaysian Nationhood</i>	3(3+0)
1.2	SKP2203	Tamadun Islam dan Tamadun Asia/ <i>Asian and Islamic Civilizations</i>	2(2+0)
1.3	SKP2204	Hubungan Etnik/ <i>Ethnic Relation</i>	2(2+0)

2. FAKULTI EKONOMI DAN PENGURUSAN

2.1	ACT2112	Perakaunan Pengenalan/ <i>Introductory Accounting</i>	4(4+0)
2.2	MGM3123	Pengurusan Sumber Manusia/ <i>Human Resource Management</i>	3(3+0)
2.3	MGM3180	Asas Keusahawanan/ <i>Basic Entrepreneurship</i>	3(2+1)
2.4	MGM3211	Prinsip Pemasaran/ <i>Principles of Marketing</i>	3(3+0)
2.5	MGM4184	Pengurusan Perniagaan Kecil/ <i>Small Business Management</i>	3(3+0)
2.6	MGM4174	Pengurusan Perkhidmatan/ <i>Services Management</i>	3(3+0)

3. FAKULTI BAHASA MODEN DAN KOMUNIKASI

3.1	BBI2423	<i>Academic Interaction and Presentation</i>	3(2+1)
3.2	BBI2424	<i>Academic Writing</i>	3(2+1)
3.3	BBI2410	Skills in Grammar	3(3+0)

4. FAKULTI PERTANIAN

4.4	PLP3001	Perlindungan Tumbuhan/ <i>Crop Protection</i>	4(3+1)
4.5	PLP3204	Patologi Tumbuhan Asas/ <i>Fundamentals of Plant Pathology</i>	4(3+1)
4.6	PRT2008	Pertanian dan Manusia/ <i>Agriculture and Man</i>	2(2+0)
4.7	SST4501	Mikrobiologi Tanah Lanjutan/ <i>Advanced Soil Microbiology</i>	3(2+1)

5. FAKULTI SAINS

5.1	BGY3001	Biologi Sel dan Perkembangan/ <i>Cellular and Developmental Biology</i>	4(3+1)
5.2	BGY3101	Biodiversiti Mikroorganisme dan Tumbuhan/ <i>Microorganism and Plant Biodiversity</i>	4(3+1)
5.3	BGY3102	Biodiversiti Haiwan/ <i>Animal Biodiversity</i>	4(3+1)
5.4	BGY3201	Struktur dan Fungsi Tumbuhan/ <i>Plant Structure And Function</i>	4(3+1)
5.5	BGY3202	Struktur dan Fungsi Haiwan/ <i>Animal Structure And Functon</i>	3(2+1)
5.6	BGY3301	Fisiologi Tumbuhan/ <i>Plant Physiology</i>	4(3+1)

5.7	BGY3302	Fisiologi Haiwan/ <i>Animal Physiology</i>	4(3+1)
5.8	BGY3401	Ekologi/ <i>Ecology</i>	3(2+1)
5.9	BGY3501	Genetik/ <i>Genetics</i>	4(3+1)
5.10	BGY4102	Kimotaksonomi Tumbuhan/ <i>Plant Chemotaxonomy</i>	4(3+1)
5.12	BGY4105	Fikologi/ <i>Phycology</i>	3(2+1)
5.13	BGY4106	Biologi Organisma Akuatik Komersil/ <i>Biology Of Commercial Aquatic Organisms</i>	4(3+1)
5.14	BGY4107	Biologi dan Propagasi Alga Komersial/ <i>Biology And Propagation Of Commercial Algae</i>	4(3+1)
5.16	BGY4302	Fisiologi Persekitaran (Tumbuhan)/ <i>Environmental Physiology (Plant)</i>	3(2+1)
5.17	BGY4402	Ekologi Hidupan Liar/ <i>Wildlife Ecology</i>	4(3+1)
5.18	BGY4403	Ekotoksikologi/ <i>Ecotoxicology</i>	4(3+1)
5.19	BGY4404	Limnologi dan Oseanografi/ <i>Limnology And Oceanography</i>	4(3+1)
5.21	BGY4406	Biologi dan Ekologi Rumpun Laut/ <i>Biology And Ecology Of Seagrasses</i>	4(3+1)
5.22	BGY4501	Polimorfisme Genetik/ <i>Genetic Polymorphisms</i>	4(3+1)
5.23	BGY4502	Genetik dan Pembiakbakaan Organisma Akuatik/ <i>Genetics And Breeding Of Aquatic Organisms</i>	4(3+1)
5.24	BGY4504	Genetik Populasi/ <i>Population Genetics</i>	4(3+1)
5.25	BGY4505	Genetik Kuantitatif/ <i>Quantitative Genetics</i>	4(3+1)
5.26	BGY4407	Pengurusan Ekosistem Akuatik/ <i>Aquatic Ecosystem Management</i>	4(4+0)
5.27	BGY4408	Limnologi Gunaan/ <i>Applied Limnology</i>	4(3+1)
5.28	CHM2000	Kimia Am/ <i>General Chemistry</i>	4(3+1)
5.29	CHM3010	Kimia Fizik dan Tak Organik/ <i>Physical and Inorganic Chemistry</i>	4(3+1)
5.30	CHM3201	Kimia Organik I/ <i>Organic Chemistry I</i>	4(3+1)
5.32	MTH3003	Statistik bagi Sains Gunaan/ <i>Statistics for Applied Sciences</i>	4(3+1)
5.33	PHY2001	Fizik Am/ <i>General Physics</i>	4(3+1)

ELEx SCHEME FOR 4 YEARS PROGRAMMES FROM SEPTEMBER 2013

MUET Band	Graduation Requirements for 4-year programmes
1 & 2	3 BBI + 3 CEL + 24 LAX points
3 & 4	2 BBI + 2 CEL + 36 LAX points
5 & 6	3 CEL + 36 LAX points

Sem	4 - Years Programme					
	MUET 1 & 2		MUET3 & 4		MUET 5 & 6	
Sem 1	BBI2422	CEL101	CEL102	LAX	LAX	
Sem 2	LAX	CEL102	BBI2423		CEL103	
Sem 3	BBI2423		BBI2424		LAX	
Sem 4	BBI2424		LAX		Choose ONE : CEL104/105	
Sem 5	LAX		LAX		LAX	
Sem 6	Choose ONE : CEL105/106/107		Choose ONE : CEL105/106/107		LAX	
Sem 7	LAX		LAX		Choose ONE : CEL105/106/107	
Sem 8	LAX <u>or</u>	OPTIONS : CEL104/105/106/107	LAX <u>or</u>	OPTIONS : CEL104/105/106/107	LAX <u>or</u>	OPTIONS : CEL104/105/106/107

Note :

Students who are away on Industrial Training in any semester need not enroll in any course or LAX for that particular semester, but they must enroll in a course LAX in subsequent semesters.

BBI courses

- BBI2422 (Reading for Academic Purpose)
- BBI2423 (Academic Interaction and Presentation)
- BBI2424 (Academic Writing)

CEL courses

- CEL101 (Vocabulary and Grammar for Communication)
- CEL102 (Effective Listening and Speaking)
- CEL103 (Writing Academic Texts)
- CEL104 (Oral Presentation)
- CEL105 (Spoken Communication for the Workplace)
- CEL106 (Communication for Professional Development)
- CEL107 (Written Business Communication)

LAX

- LAX (6 points or 12 points)
- 1 point = 2 hours per week

Pre-requisites for courses

- CEL102 : Level 2 in CEL101 or MUET Band 5-6
- CEL103 : Passed BBI2424 or MUET Band 5 - 6
- BBI2423 : Level 2 in CEL102
- BBI2424 : Passed BBI2423
- CE2104,105,106,107 :Passed BBI2424 or MUET Band 5 – 6