UNIVERSITI SAINS MALAYSIA

BACHELOR *of* ENGINEERING

School of MECHANICAL ENGINEERING

2017/2018

www.usm.my

USM Vision

Transforming Higher Education for a Sustainable Tomorrow

USM Mission

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

STUDENT'S PERSONAL INFORMATION

Full Name	
Identity Card (IC)/Passport No.	
Current Address	
Permanent Address	
E-mail Address	
Telephone No. (Residence)	
Mobile Phone No. (if applicable)	
School	
Programme of Study	

CONTENT **PAGE**

I.	VISION AND MISSION		i
II.	STUDENT'S PERSONAL INFORMATION		ii
III.	CONTENT		iii
IV.	ACADEMIC CALENDAR		v
1.0	**INTRODUCTION**		
	1.1	History and Development	1
	1.2	Philosophy and Objectives	3
	1.3	Outcome Based Education	3
	1.4	Continual Quality Improvement System	4
	1.5	External Examiner	4
	1.6	Industry Advisory Board	5
	1.7	Division of Industry & Community Network	5
	1.8	Stakeholder	5
	1.9	Teaching Delivery Method	5
	1.10	Course Code	6
	1.11	Programme Structure	7
	1.12	Courses Offering	8
	1.13	Graduation Requirements	10
2.0	**ACADEMIC SYSTEM AND GENERAL INFORMATION**		
	2.1	Course Registration	11
	2.2	Interpretation of Unit/Credit/Course	19
	2.3	Examination System	19
	2.4	Unit Exemption	24
	2.5	Credit Transfer	26
	2.6	Academic Integrity	28
	2.7	USM Mentor Programme	32
	2.8	Student Exchange Programme	33
	2.9	Ownership of Students' Dissertation/ Research Project/ Theses and University's Intellectual Property	34
3.0	**UNIVERSITY REQUIREMENTS**		
	3.1	Summary of University Requirements	35
	3.2	Bahasa Malaysia	36
	3.3	English Language	37
	3.4	Local Students - Islamic and Asian Civilisation/ Ethnic Relations/Core Entrepreneurship	39
	3.5	International Students - Malaysian Studies/Option	40
	3.6	Co-Curriculum/Skill Courses/Foreign Language Courses/ Options	41

4.0 SCHOOL OF MECHANICAL ENGINEERING

4.1 Introduction 46
4.1.1 Outcome Based Education (OBE) 47
4.1.2 Bachelor of Mechanical Engineering (Honours) 48
4.1.3 Bachelor of Manufacturing Engineering with Management (Honours) 49
4.2 Philosophy and Objective 50
4.3 Main Administrative Staff 51
4.4 List of Academic Staff 52
4.5 Industry/Community Advisory Panel (ICAP) 54
4.6 Laboratories Facilities 54
4.7 Job Opportunities 55
4.8 Post Graduate Studies and Research Programme 55
4.9 Program for Bachelor of Mechanical Engineering [Honours] 57
4.9.1 Curriculum 59
4.9.2 Course – Programme Outcome Matrix 63
4.9.3 Course Description 64
4.10 Program for Bachelor of Manufacturing Engineering with Management [Honours] 101
4.10.1 Curriculum 103
4.10.2 Course – Programme Outcome Matrix 107
4.10.3 Course Description 108

COURSE INDEX 125
STUDENT'S FEEDBACK 127

ACADEMIC CALENDAR - ACADEMIC SESSION 2017/2018

FOR ALL SCHOOLS (EXCEPT THE SCHOOL OF MEDICAL SCIENCES AND SCHOOL OF DENTAL SCIENCES)

***Registration for New Students (3 September 2017) / Orientation Week 3-10 September 2017**

SEM	WEEK	ACTIVITY	DATE	REMARKS
ONE	1	Teaching & Learning Period (T&LP - 5 Weeks)	Monday, 11.09.2017 - Sunday, 17.09.2017	01.09.2017, Friday - Eid-ul adha 09.09.2017, Saturday - Agong's Birthday
	2		Monday, 18.09.2017 - Sunday, 24.09.2017	16.09.2017, Saturday - Malaysia Day
	3		Monday, 25.09.2017 - Sunday, 01.10.2017	21.09.2017, Thursday - Maal Hijrah 1439
	4		Monday, 02.10.2017 - Sunday, 08.10.2017	
	5		Monday, 09.10.2017 - Sunday, 15.10.2017	
	6	Mid Semester Break	Monday, 16.10.2017 - Sunday, 22.10.2017	18.10.2017, Wednesday - Deepavali**
	7	Teaching & Learning Period (T&LP - 9 Weeks)	Monday, 23.10.2017 - Sunday, 29.10.2017	
	8		Monday, 30.10.2017 - Sunday, 05.11.2017	
	9		Monday, 06.11.2017 - Sunday, 12.11.2017	
	10		Monday, 13.11.2017 - Sunday, 19.11.2017	
	11		Monday, 20.11.2017 - Sunday, 26.11.2017	
	12		Monday, 27.11.2017 - Sunday, 03.12.2017	01.12.2017, Friday - Prophet Muhammad's Birthday
	13		Monday, 04.12.2017 - Sunday, 10.12.2017	
	14		Monday, 11.12.2017 - Sunday, 17.12.2017	
	15		Monday, 18.12.2017 - Sunday, 24.12.2017	
	16	Revision Week	Monday, 25.12.2017 - Sunday, 31.12.2017	25.12.2017, Monday-Christmas
	17	Examinations (3 Weeks)	Monday, 01.01.2018 - Sunday, 07.01.2018	01.01.2018, Monday-New Year 2018
	18		Monday, 08.01.2018 - Sunday, 14.01.2018	
	19		Monday, 15.01.2018 - Sunday, 21.01.2018	
	20	Mid Semester Break (3 Weeks)	Monday, 22.01.2018 - Sunday, 28.01.2018	
	21		Monday, 29.01.2018 - Sunday, 04.02.2018	31.01.2018. Wednesday- Thaipusam**
	22		Monday, 05.02.2018 - Sunday, 11.02.2018	
TWO	1/23	Teaching & Learning Period (T&LP - 7 Weeks)	Monday, 12.02.2018 - Sunday, 18.02.2018	16 & 17.02.2018, Friday & Saturday - Chinese New Year
	2/24		Monday, 19.02.2018 - Sunday, 25.02.2018	
	3/25		Monday, 26.02.2018 - Sunday, 04.03.2018	
	4/26		Monday, 05.03.2018 - Sunday, 11.03.2018	
	5/27		Monday, 12.03.2018 - Sunday, 18.03.2018	
	6/28		Monday, 19.03.2018 - Sunday, 25.03.2018	
	7/29		Monday, 26.03.2018 - Sunday, 01.04.2018	
	8/30	Mid Semester Break	Monday, 02.04.2018 - Sunday, 08.04.2018	
	9/31	Teaching & Learning Period (T&LP – 7 Weeks)	Monday, 09.04.2018 - Sunday, 15.04.2018	
	10/32		Monday, 16.04.2018 - Sunday, 22.04.2018	
	11/33		Monday, 23.04.2018 - Sunday, 29.04.2018	
	12/34		Monday, 30.04.2018 - Sunday, 06.05.2018	01.05.2018, Tuesday - Labour Day
	13/35		Monday, 07.05.2018 - Sunday, 13.05.2018	
	14/36		Monday, 14.05.2018 - Sunday, 20.05.2018	
	15/37		Monday, 21.05.2018 - Sunday, 27.05.2018	Examinations start on 23.05.2018 - 13.06.2018
	16/38	Examinations (3 Weeks)	Monday, 28.05.2018 - Sunday, 03.06.2018	29.05.2018, Tuesday - Wesak Day 02.06.2018, Saturday - Nuzul Al-Quran
	17/39		Monday, 04.06.2018 - Sunday, 10.06.2018	
	18/40		Monday, 11.06.2018 - Sunday, 17.06.2018	15 & 16.06.2018, Friday & Saturday - Eid-ul fitr**
*KSCP	19/41	Long Vacation/ Industrial Training/ KSCP* (11 Weeks) *T&LP *Examination	Monday, 18.06.2018 - Sunday, 24.06.2018	
	20/42		Monday, 25.06.2018 - Sunday, 01.07.2018	
	21/43		Monday, 02.07.2018 - Sunday, 08.07.2018	07.07.2018, Saturday - Penang Heritage & Penang Governor's Birthday
	22/44		Monday, 09.07.2018 - Sunday, 15.07.2018	
	23/45		Monday, 16.07.2018 - Sunday, 22.07.2018	
	24/46		Monday, 23.07.2018 - Sunday, 29.07.2018	28.07.2017, Saturday - Agong's Birthday
	25/47		Monday, 30.07.2018 - Sunday, 05.08.2018	
	26/48		Monday, 06.08.2018 - Sunday, 12.08.2018	
	27/49		Monday, 13.08.2018 - Sunday, 19.08.2018	
	28/50		Monday, 20.08.2018 - Sunday, 26.08.2018	22.08.2018, Wednesday-Eid-ul-adha**
	29/51		Monday, 27.08.2018 - Sunday, 02.09.2018	31.08.2018, Friday - National Day

*Courses during the Long Vacation (KSCP)

**This Academic Calendar is subject to change

1.0 INTRODUCTION

This Engineering Handbook is specially prepared for the undergraduate engineering students of Universiti Sains Malaysia who will commence their first year studies in the academic year of 2017/2018. This handbook contains concise information that will prove useful in helping students to understand the university's system of study as well as to adopt oneself to university life.

Information in this handbook covers various aspects such as the programme structure of the Bachelor of Engineering degree, the academic system, types of courses, synopsis of the courses, student status, examination and evaluation system, information about the engineering schools, reference materials and academic staff list. This information would give a clear picture to the students for them to plan their academic studies, understand the field of studies that they are following and adapt themselves to the teaching and learning environment of the university.

Universiti Sains Malaysia offers Bachelor of Engineering (with Honours) programmes through its six schools of engineering:

- School of Aerospace Engineering
- School of Chemical Engineering
- School of Civil Engineering
- School of Electrical and Electronic Engineering
- School of Materials and Mineral Resources Engineering
- School of Mechanical Engineering

1.1 History and Development

In 1972, Universiti Sains Malaysia established the School of Applied Science at the Main Campus in Penang and offered basic fields of engineering studies. The fields of studies offered at the time were Electronic Technology, Polymer Technology, Food Technology, Materials Technology and Mineral Resources Technology.

In 1984, the School of Applied Science was restructured and given a new name, the School of Engineering Science and Industrial Technology. This restructuring, which corresponded to the development of Malaysia's Industrial Masterplan that is in turn related to the country's human utilization needs, gave birth to three new schools. They were the School of Industrial Technology which focused on offering studies in fields such as polymer and food technologies, the School of Electrical and Electronics Engineering and the School of Materials and Mineral Resources Engineering.

The expansion that took place required an increase in the physical space of the campus. Since the physical area of USM in Penang at the time was rather limited, a new area in the state of Perak was identified as the site for the development of a branch campus. A decision was reached whereby all fields of engineering studies were transferred to Perak while the School of Industrial Technology remained in Penang. In 1986, the School of Electrical and Electronics Engineering and the School of Materials and Mineral Resources Engineering moved to a temporary campus at the old Ipoh Town Council

building while waiting for the construction of the USM branch campus in Bandar Baru Seri Iskandar, Perak Tengah District, Perak to be completed. The temporary campus was named USM Perak Branch Campus (USMKCP – USM Kampus Cawangan Perak).

In 1987, construction began at the site of USM Perak Branch Campus in Bandar Baru Seri Iskandar. On 1st January 1989, the scope of engineering studies was expanded further with the establishment of two new schools of engineering: the School of Civil Engineering and the School of Mechanical Engineering.

By the end of November 1989, all four USM engineering schools began moving to USM Perak Branch Campus in Seri Iskandar in stages and the moving process finally ended in April 1990. The Ipoh Town Council building which housed USM's temporary campus was handed back to the Town Council in a glorious ceremony that was graced by the DYMM Seri Paduka Baginda Yang Dipertuan Agong, Sultan Azlan Shah.

In 1992, USM established its fifth engineering school, the School of Chemical Engineering. Two years later, efforts to offer studies in the field of Aerospace Engineering went underway. On 17th of May 1998, the USM Aerospace Engineering Unit was established and on the 1st of March 1999 the unit was upgraded to the School of Aerospace Engineering.

In 1997, the government decided to transfer USMKCP back to Penang. The new campus site was located in Seri Ampangan, Nibong Tebal, Seberang Perai Selatan, Penang while USMKCP's campus site in Seri Iskandar was taken over by the Universiti Teknologi Petronas (UTP). The Engineering Campus moved in stages in 2001. USM's Engineering Campus in Seri Ampangan, Nibong Tebal began its operations in the 2001/2002 Academic Session in June 2001.

In 2007, USM was appointed as one of the four research universities by the Ministry of Higher Education [MoHE] through a rigorous evaluation process thus elevating its status to the top among more than 100 public and private universities and colleges in Malaysia. In the same year, USM was rated as the only "excellent" (or 5-Star) university in the Academic Reputation Survey conducted by the Malaysian Qualification Agency (MQA).

On 4th of September 2008, USM was granted with an APEX (the Accelerated Programme for Excellence) status by the Malaysian's government. This status requires USM to transform its system in order to move up its World University Rankings with a target of top 100 in five years and top 50 by 2020.

USM's transformation plan, entitled "Transforming Higher Education for a Sustainable Tomorrow" will embark on numerous transformational journeys, including revamping most of its activities pertaining to nurturing and learning, research and innovation, services, students and alumni and the management of the university as a whole.
The University takes steps to improve the three core pillars of its strengths, [i] concentration of talent, [ii] resources and [iii] acculturation of supportive governance.

1.2 Philosophy and Objectives

The philosophy and objective of the Bachelor of Engineering programme at the Universiti Sains Malaysia is to produce qualified engineering graduates in various fields who are able to find solutions to diverse problems through innovative thinking.

The engineering programme at USM aims to produce professional engineers who are responsible towards research and development, project management, production planning and control and accreditation of equipments in various fields in the country.

Thus all courses that are being offered in the engineering programme blend together the theoretical and practical aspects of learning according to the relevant needs of the industrial public sectors. The fields of engineering studies in USM are up to date and challenging so as to fulfil the nation's industrial development needs. Students will also be equipped with fundamentals of business practice such as finance, marketing and management as well as co-curricular activities so that the students could adapt themselves well to the current state of affairs.

1.3 Outcome Based Education

All bachelor engineering programmes at the Universiti Sains Malaysia have adopted the Outcome Based Education (OBE) since the academic year of 2006/2007. The OBE emphasises that the professional attributes of the graduates satisfy the current and future needs of the country and global market in general. For this, the programme educational objectives of each programme offered at the Engineering Schools are developed through interviews and surveys from the stakeholders including industries, government, parents, students, alumni and the university lecturers. This signifies that the programmes offered in USM are relevance to the current need of industries and society and for the preparation of high quality future talents.

With the agreed programme educational objectives, the curricular structure of each programme is planned accordingly to ensure that our graduate possess the quality attributes as suggested by the Engineering Accreditation Council (EAC) and Board of Engineer Malaysia (BEM) are achieved. The attributes are listed in Section 4.1.1.

1.4 Continual Quality Improvement System

To realize the Outcome Based Education, a few mechanisms have been identified to be incorporated into the continual quality improvement system for the Bachelor of Engineering programmes. Feedbacks are obtained from industries through the Industrial Advisory Panel which consist of at least five engineers or managers from industrial sectors.

Feedbacks from the students are obtained from the Lecturer-Student Committee and Interview Session with each student before their convocation. Feedbacks from the alumni are obtained from the USM Alumni Relations Unit and the School's alumni communities such as email, webpage and Facebook. All these feedbacks are incorporated for deliberations and approval by the Curriculum Review Committee which convenes annually to identify any particular course or programme that need to be revamped or to undergo minor/major changes.

1.5 External Examiner

Universiti Sains Malaysia has appointed external examiners to:

- Advise the School/Centre concerned regarding matters pertaining to the structure and contents of its undergraduate programmes, research and administration related to examinations. Attention is also focused towards post-graduate programmes where applicable.
- Scrutinise and evaluate all draft question papers prepared by Internal Examiners.
- Visit the university during the period of the examinations in order to be familiar with the work of the School/Centre, the available physical facilities and also to participate in activities related directly to the conduct of the examinations. In order to make the visit more meaningful and to obtain a better understanding of the University, an External Examiner who has been appointed for a term of three academic sessions should visit the school/centre during the first academic session of his appointment.
- Scrutinise and evaluate such answer scripts as may be required by the Dean/Director of the School/Centre concerned and to ensure that the standards set by Internal Examiners (of the discipline to which he/she is appointed) are the same as those at other Universities of International standing.
- Ensure uniformity in the evaluation of answer scripts by the Internal Examiners between candidates of the same standard.
- Examine the oral component or viva-voce where required.
- Hold seminars/meetings with the academic staffs/students if required.

1.6 Industry Advisory Board

The engineering schools have set up an Industrial Advisory Board for all offered engineering programmes and various meetings have and will be conducted from time to time. Each school has appointed prominent members from the industry and relevant institutions to be in the Advisory Board. The Industrial Advisory Board members will discuss and give their input on the Industrial Training; Outcome Based Education (OBE) implementation, curriculum development, the requirement of soft skills and other relevant issues to the School to improve the quality of programmes and graduates.

1.7 Division of Industry & Community Network

To foster closer, effective, meaningful and sustainable linkages and partnership with the industry and the community, i.e. the world outside Universiti Sains Malaysia, a new division, the Division of Industry & Community Network was established within the Chancellery in September 2007. This new division is headed by a Deputy Vice Chancellor (Industry and Community Network). The function of this division is to match between the knowledge/expertise, facilities and resources of the university to the needs, aspirations and expectations of the industry and the community to result in a win-win situation.

1.8 Stakeholder

In line with the Engineering Accreditation Council (EAC) requirements for involvement of stakeholders in establishing the programme educational objectives, their inputs have been continuously gathered from surveys and direct communications. The University has identified the stakeholders as follows:

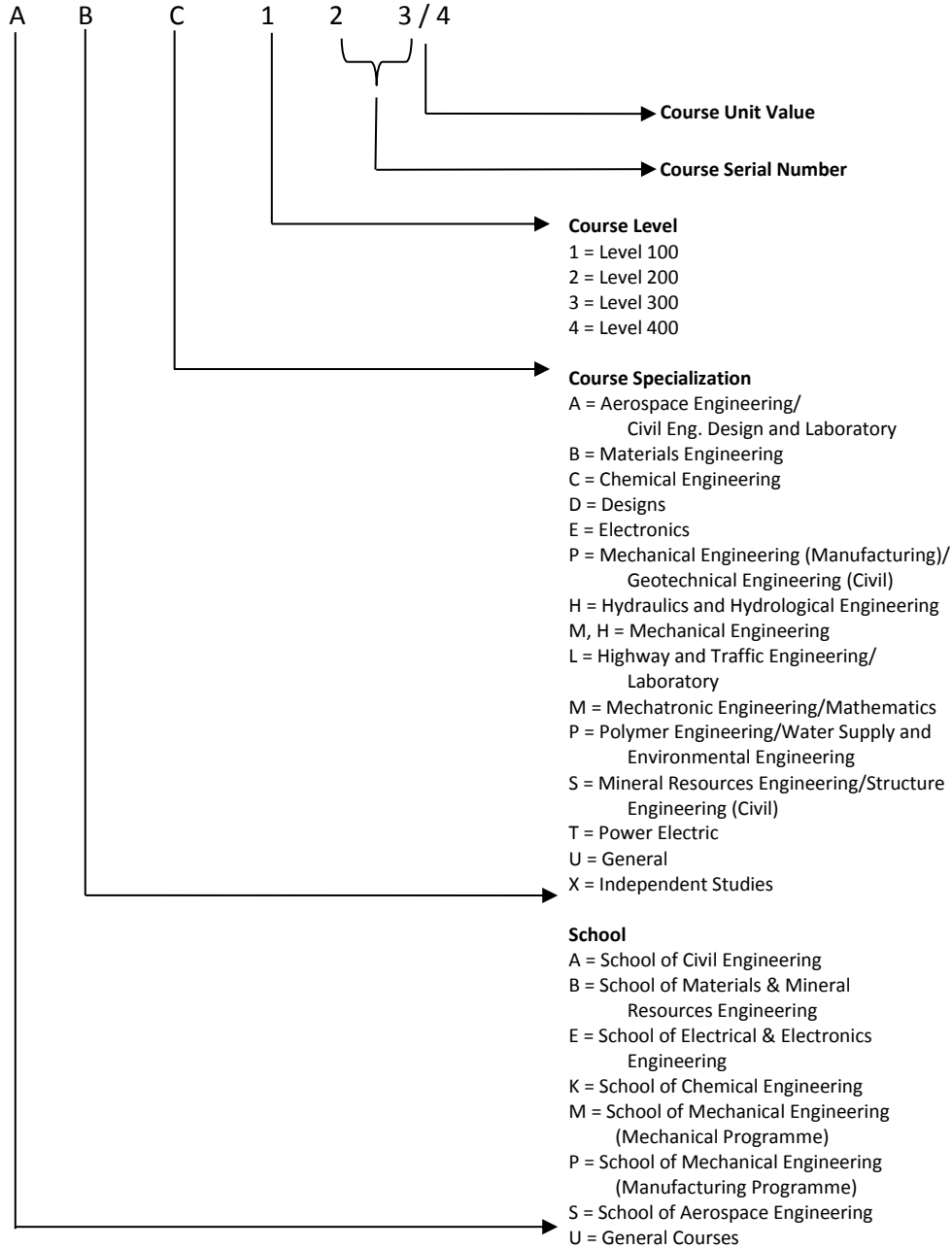
- Academic Staffs (University)
- Employers (industry and government)
- Alumni
- Students
- Parents

1.9 Teaching Delivery Method

Other contributing components to the curriculum such as a variety of teaching and learning (delivery) modes, assessment and evaluation methods are designed, planned and incorporated within the curriculum to enable students to effectively develop the range of intellectual and practical skills, as well as positive attitudes. The assessments to evaluate the degree of the achievement of the Programme Outcomes by the students are done both at the programme as well as at course levels. The teaching and learning methods designed enable students to take full responsibility for their own learning and prepare themselves for lifelong learning and knowledge acquisition.

1.10 Course Code

Each course offered by the respective School is denoted by the following code of ABC 123/4. The alphabets and numbers represent:-



1.11 Programme Structure

The Structure of the Engineering Degree Programme is as follows:-

	COURSE	UNITS	REMARKS
(i)	CORE	108	
(ii)	ELECTIVE	12	Students may select these courses from list as determined by the respective programme
(iii)	UNIVERSITY REQUIREMENTS	15	
	Compulsory (12 units)		
	(a) Bahasa Malaysia	2	
	(b) English Language	4	
	(c) Islamic and Asian Civilisations	2	
	(d) Ethnic Relations	2	
	(e) Entrepreneurship	2	
	Optional Course (3 units)		
	(a) Co-curriculum/Optional/Skills	3	
	TOTAL:	**135**	

Note:

For graduation, students are required to complete at least 135 units, with 'pass' grade for all the courses.

1.12 Courses Offering

Students are required to register for the undergraduate courses in two semesters for each academic session that is Semester 1 and Semester 2. Courses are offered and examined in the same semester. Courses offered are categorized into four levels, via levels 100, 200, 300 and 400, suitable to the requirements of a four-year study programme.

Core Courses

Core course is a compulsory course package which aims at giving a deeper understanding of an area of specialization/major. Students need to accumulate 108 units of the core courses which have been identified by each school.

Elective Courses

Students who do not choose a Minor area are required to take Elective courses. Students need to accumulate no less than 12 units from the list of courses suggested and acknowledged by the school.

Optional Courses

Optional courses are courses chosen by the students from among those that are outside of their programmes of study.

The main objective of an Optional course is as a substitute course for students who do not take Co-curriculum courses or Skill/Analysis courses.

Audit Courses

In principle, the university allows students to register for any courses on an audit basis for the purpose of enhancing the students' knowledge in specific fields during the duration of their study. However, the units of any such audit courses will not be taken into consideration for graduation purposes.

The registration procedures for courses on an audit basis are as follows:-

(a) Students can register for courses on an audit basis for the purpose of augmenting his/her knowledge in specific fields. Registration for the said course must be within the course registration week.

(b) Only students of active status are allowed to register for courses on an audit basis.

(c) Courses registered for on an audit basis are designated as code 'Y' courses. This designation will be indicated on the relevant academic transcript. A space at the bottom of the academic transcript will be reserved for listing the courses registered for on an audit basis.

(d) Courses registered for on an audit basis will not be taken into consideration in determining the minimum and maximum units of courses registered for.

(e) Students must fulfil all course requirements. Student who register for courses on an audit basis, are not obligated to sit for any examinations pertaining to that course. A grade 'R' will be awarded irrespective as to whether the student had or had not sat for the examination.

Laboratory Work/Practical, Engineering Practice and Industrial Training

Programmes in the School of Engineering place a great emphasis on laboratory work/practical. Laboratory work/practical is an important and essential aspect in most courses. There are also courses that the assessment is based on 100% works in laboratory work/practical. It aims to provide students with a better understanding of the subject matter delivered through lectures.

Students are required to submit laboratory/practical reports which are part of the course work assessment for courses delivered through lectures and the laboratory/practical component only. Attendance is compulsory for all levels of study and students may be barred from taking the written examination if their attendance is unsatisfactory.

Apart from attending classes (lectures and laboratory/practical), students must also undergo the Engineering Practice Course and Industrial Training.

General Objectives of Engineering Practice

To expose to the students about the importance and the link between the theoretical and practical aspects of engineering, and to familiarise them with the environment/theoretical situations in use, available resources and their scarcity so that the academic aspects of a course can be understood better and used more effectively.

To raise awareness of the environment/industrial situations, practices, resources and their scarcity. Therefore, students will have the opportunity to equip themselves to face future challenges in their academic studies as well as in their future training.

The Engineering Practice will be conducted in the following manner:

The training will be conducted on and off campus. There are two levels which are compulsory for all engineering students:

(i) Engineering Practice Course

The Engineering Practice Course is a basic training course on mechanical, manufacturing and electrical engineering. The training includes engineering workshops, introduction to manufacturing processes and electrical circuit. Engineering students will also be exposed to methods of engineering planning and project implementation. The duration of the

training is 14 weeks and during this period, students will be supervised by the academic staff on duty.

(ii) Industrial Training

This course is conducted over 10 weeks during the long break after Semester II at level 300. Students are exposed to the actual operations of industries, locally and abroad. It is hoped that students will be able to learn and experience useful knowledge and skills while undergoing training as they have already taken the Engineering Practice Course.

It is hoped that the training will provide students with a good foundation in engineering. This is a 5-unit course and students will be awarded a Pass/Fail grade upon completion.

1.13 Graduation Requirements

In order to be eligible for graduation from the programmes offered by the School of Mechanical Engineering, students must fulfil the following requirements:-

(a) Fulfil the minimum residential requirements during the course of studies
(b) Fulfil all the credit unit requirements for all required course from each categories (108 unit Core courses, 15 units of University Requirements courses, 12 unit of elective courses), giving a total of 135 credit units.
(c) Obtain a grade of at least 'C' for all courses taken (applies to intake 2015/2016 onwards)

2.0 ACADEMIC SYSTEM AND GENERAL INFORMATION

2.1 Course Registration

Registration of courses is an important activity during the period of study at the university. It is the first step for the students to sit for the examination at the end of each semester. Signing up for the right courses each semester will help to facilitate the graduation of each student from the first semester till the final semester.

2.1.1 Course Registration Secretariat for the Bachelor Degree and University's Diploma Students

Student Data and Records Section (SDRP)
Academic Management Division
Registry
(Level 1, Chancellory Building)

Tel. No.	:	04-653 2925/2924/2923
Fax No.	:	04-657 4641
E-Mail	:	sdrp@usm.my
Website	:	http://registry.usm.my/updr

The SDRP office is the Secretariat/Coordinator of course registration for the Bachelor Degree and Diploma Programme of the University.

Further inquiries regarding course registration activities for the first degree and diploma can be made at the office of the Student Data and Records Section. Please refer to the contact number above.

2.1.2 Course Registration Platform

(i) *E-Daftar* (E-Registration)

E-Daftar is a platform for on-line course registration. The registration is done directly through the Campus Online portal **(https://campusonline.usm.my)**.

Registration under *E-Daftar* for Semester 1 usually starts 1-2 days after the release of 'Official' examination results of Semester 2 of the previous academic year. The system closes a day before Semester 1 begins (in September). *E-Daftar* registration for Semester 2 usually starts 1-2 days after the Semester 1 'Provisional' examination results are released until a day before Semester 2 begins (in February).

The actual timing of registration under *E-Daftar* will be announced by the Student Data and Records Section during the Revision Week of every semester and will be displayed on the respective Schools/Centres/Hostels' bulletin boards and in the USM's official website.

Under *E-Daftar*, students can register for any courses offered by USM, except co-curriculum courses. Registration of co-curriculum courses is still placed under the administration of the Director of the Centre for Co-Curriculum Programme at the Main Campus or the Coordinator of the Co-Curriculum Programme at the Engineering Campus and the Coordinator of the Co-Curriculum Programme at the Health Campus.

Co-Curriculum courses will be included in the students' course registration account prior to the *E-Daftar* activity, if their pre-registration application is successful.

(ii) Access to *E-Daftar* System

a. *E-Daftar* System can be accessed through the Campus Online portal **(https://campusonline.usm.my)**.
b. Students need to use the E-Mail ID and password to access their profile page, which includes the *E-Daftar* menu.
c. Students need to click on the *E-Daftar* menu to access and register for the relevant courses.
d. Students are advised to print the course registration confirmation slip upon completion of the registration process or after updating the course registration list (add/ drop) within the *E-Daftar* period.
e. The *E-Daftar* system can only be accessed for a certain period of time.
f. Guidelines to register/gain access to the *E-Daftar* portal are available at the Campus Online portal's main page.

(iii) Online Course Registration (OCR) in Schools/Centres

OCR activities are conducted in the Schools/Centres and are applicable to students who are academically active and under Probation (P1/P2) status. Students who face difficulties registering their courses during the *E-Daftar* period can register their courses during the official period of OCR alternatively. Each school is responsible for scheduling this activity.
The official period for OCR normally starts on the first day of the semester (without the penalty charge of RM50.00). After this

official date, the registration will be considered late (a penalty of RM50.00 will be imposed if no reasonable excuse is given).

During the non-penalty period, OCR will be conducted at each School. After Week Six, all registration, including adding and dropping of courses will be administered by the Examination and Graduation Section Office (Academic Management Division, Registry).

2.1.3 The Frequency of Course Registration in One Academic Session

(i) Normal Study Semester
- 2 times per year (beginning of Semester **1** & Semester **2**)

(ii) Long semester break (about one month after the final examination of Semester **2**)
- Once per year

2.1.4 General Guidelines before Students Register for Courses

(i) Matters/Information/Documents required to be noted/considered/ referred to by students before course registration:

- Refer to the respective School's website to get updated information for courses offered or course registration.
- Decide on courses to be registered according to the semester as stipulated in the Study Programme Guide Book.
- List of courses to be registered and number of units (unit value) for each course.
- Provide Cumulative Statement of Grades (Cangred).
- Construct Teaching and Learning Timetable for the registered courses (to avoid overlapping in timetable).
- Read and comprehend the reminders regarding policies/general requirements for the course registration.

(ii) The number of maximum and minimum units that can be registered in every semester **is** stated below:

Academic Status	Minimum Units	Maximum Units
Active	9	21
P1	9	12
P2	9	10

Determination of academic status in a semester is based on the students' academic performance in the previous semester (Grade Point Average, GPA):

* GPA 2.00 & above = Active Academic Status
* GPA 1.99 & below = Probation Academic Status (P1/P2)

- Students who meet the minimum period of residency (6 semesters for a 3 year programme, 7 semesters for a 3.5 year programme or 8 semesters for a 4 year programme) are allowed to register courses with a total of less than 9 units. The semester in which the student is on leave is not considered for the residency period.

(iii) Type of course codes during registration:

T = Core courses
E = Elective courses
M = Minor courses
U = University courses

} Grade and number of units obtained from these courses are considered for graduation

Two (2) other course codes are:
Y = audit courses
Z = prerequisite courses

Grade and number of units obtained from these courses are not considered for graduation.

(iv) Advice and approval of the Academic Advisor

- Approval from the Academic Advisor is required for students under Probation status before they are allowed to register during the OCR period. Probation students cannot access *E-Daftar* for registration.
- Approval from the Academic Advisor is not required for students under Active Status to register courses through *E-Daftar*.

(v) Students are not allowed to register and repeat any course for which they have achieved a grade 'C' and above.

2.1.5 Information/Document Given To All Students through Campus Online Portal (https://campusonline.usm.my)

(i) The information of Academic Advisor.

(ii) Academic information such as academic status, GPA value, CGPA value and year of study.

(iii) Cangred and Course Registration Form.

(iv) List of courses offered by all Schools/Centres.

(v) Teaching and Learning Timetable for all Schools/Centres/Units from the three campuses.

(vi) List of pre-registered courses which have been added into the students' course registration record (if any).

(vii) Reminders about the University course registration policies/general requisites.

2.1.6 Registration of Language and Co-Curriculum Courses

(a) Registration of Language courses through *E-Daftar* is allowed.

- ❖ However, if any problem arises, registration for language courses can still be carried out/updated during the official period of OCR at the office of the School of Languages, Literacies and Translation.

- ❖ All approval/registration/dropping/adding of language courses is under the responsibility and administration of the School of Languages, Literacies and Translation.

- ❖ Any problems related to the registration of language courses can be referred to the School of Languages, Literacies and Translation. The contact details are as follows:

General Office	: 04-653 4542/ 5243/ 5248	for Main Campus students
Malay Language Programme Chairperson	: 04-6533974	
English Language Programme Chairperson	: 04-6533406	
Foreign Language Programme Chairperson	: 04-6533396	
Engineering Campus Programme Chairperson	: 04-5995407	
	: 04-5996385	
Health Campus Programme Chairperson	: 09-7671252	

(b) Registration for **co-curricular courses through *E-Daftar*** is not allowed.

- ❖ Registration for co-curricular courses is either done through pre-registration before the semester begins or during the first/second week of the semester. Co-curricular courses will be included in the students' course registration account prior to the *E-Daftar* activity, if their pre-registration application is successful.

- ❖ All approval/registration/dropping/adding of co-curricular courses is under the responsibility and administration of:

  Director of the Centre for Co-Curricular Programme, Main Campus (04-653 5242/5243/5248)

  Coordinator of the Centre for Co-Curricular Programme, Engineering Campus (04-599 5097/6385)

  Coordinator of the Centre for Co-Curricular Programme, Health Campus (09-767 7547)

(c) **Dropping of Language and Co-Curriculum courses, if necessary, must be made within the first week**. After the first week, a fine of RM50.00 will be imposed.

2.1.7 Registration of 'Audit' Courses (Y code)

Registration for the 'Audit' course (Y code) **is not allowed in the *E-Daftar***. It can only be done during the official period of OCR in the School or Centre involved. Students who are interested must complete the course registration form which can be printed from the Campus Online Portal or obtained directly from the School. Approval from the lecturers of the courses to be audited and the Dean/ Deputy Dean (Academic) (signed and stamped) in the course registration form is required.

Registration of 'Audit' courses (Y code) is not included in the calculation of the total registered workload units. Grades obtained from 'Audit' course are not considered in the calculation of CGPA and total units for graduation.

2.1.8 Registration of Prerequisite Courses (Z code)

Registration of Prerequisite courses (Z code) is included in the total registered workload (units). Grades obtained from the Prerequisite courses are not considered in the calculation of CGPA and units for graduation.

2.1.9 Late Course Registration/Late Course Addition

Late course registration or addition is not allowed after the official period of the OCR ends unless with valid reasons. General information on this matter is as follows:

(i) **Late course registration and addition are only allowed in the first to the third week** with the approval of the Dean. Students will be fined RM50.00 if the reasons given are not acceptable.

(ii) Application to add a course **after the third week** will not be considered, except for special cases approved by the University.

2.1.10 Dropping of Courses

Dropping of courses is allowed until the **end of the sixth week**.

For this purpose, students must meet the requirements set by the University as follows:

(i) Dropping Course Form must be completed by the student and signed by the lecturer of the course involved and the Dean/Deputy Dean of their respective Schools and submitted to the general office of the School/Centre which is responsible for offering the courses involved.

(ii) Students who wish to drop a language course must obtain the signature and stamp of the Dean of the School of Languages, Literacies and Translation, as well as the signature and stamp of the Dean of their respective schools.

(iii) Students who wish to drop the Co-Curriculum courses must obtain the approval of the Centre for Co-Curriculum Programme and the signature and stamp of the Dean of their respective schools.

(iv) The option for dropping courses cannot be misused. Lecturers have the right not to certify the course that the student wishes to drop if the student is not serious, such as poor attendance record at lectures, tutorials and practical, as well as poor performance in coursework. The student will be barred from sitting for the examination and will be given grade 'X' and is not allowed to repeat the course during the *Courses during the Long Vacation* (KSCP) period.

2.1.11 Course Registration Confirmation Slip

The course registration confirmation slip that has been printed/ obtained after registering the course should be checked carefully to ensure there are no errors, especially the code type of the registered courses. Any data errors for course registration must be corrected immediately whether during the period of *E-Daftar* (for students with active status only) or during the period of OCR at the Schools.

2.1.12 Revising and Updating Data/Information/Students' Personal and Academic Records

Personal and academic information for each student can be checked through the Campus Online portal (https://campusonline.usm.my).

Students are advised to always check all the information displayed on this website.

- The office of the Student Data and Records Section must be notified of any application/notification for correction/updating of personal data such as the spelling of names (names must be spelled as shown on the Identification Card), Identification Card number and address (permanent address and correspondence address).

- The office of the Student Data and Records Section must be notified of any application/ notification for correction of academic data such as information on Major, Minor, MUET result and the course code.

- The office of the Examination and Graduation Section must be notified of any application/notification for correction of the examination/results data.

2.1.13 Academic Advisor

Each School will appoint an Academic Advisor for each student. Academic Advisors comprise academic staff (lecturers) of the school. Normally, the appointment of Academic Advisors will be made known to every student during the first semester in the first year of their studies.

Academic Advisors will advise their students under their responsibility on academic-related matters. **Important advice for the students includes the registration planning for certain courses in each semester during the study period**. Before registering the course, students are advised to consult and discuss with their Academic Advisors to determine the courses to be registered in a semester.

2.2 Interpretation of Unit/Credit/Course

2.2.1 Unit

Each course is given a value, which is called a **UNIT**. The unit is determined by the scope of its syllabus and the workload for the students. In general, a unit is defined as follows:

Type of Course	Definition of Unit
Theory	1 unit is equivalent to 1 contact hour per week for 13 – 14 weeks in one semester
Practical/Laboratory/ Language Proficiency	1 unit is equivalent to 1.5 contact hours per week for 13 – 14 hours in one semester
Industrial Training/ Teaching Practice	1 unit is equivalent to 2 weeks of training

Based on the requirements of Malaysian Qualifications Framework (MQF):

One unit is equivalent to 40 hours of student learning time

[1 unit = 40 hours of Student Learning Time (SLT)]

2.2.2 Accumulated Credit Unit

Units registered and passed are known as credits. To graduate, students must accumulate the total number of credits stipulated for the programme concerned.

2.3 Examination System

Examinations are held at the end of every semester. Students have to sit for the examination of the courses they have registered for. Students are required to settle all due fees and fulfil the standing requirements for lectures/tutorials/practical and other requirements before being allowed to sit for the examination of the courses they have registered for. Course evaluation will be based on the two components of coursework and final examinations. Coursework evaluation includes tests, essays, projects, assignments and participation in tutorials.

2.3.1 Duration of Examination

Evaluated Courses	Examination Duration
2 units	1 hour for coursework of more than 40%
2 units	2 hours for coursework of 40% and below
3 units or more	2 hours for coursework of more than 40%
3 units or more	3 hours for coursework of 40% and below

2.3.2 Barring from Examination

Students will be barred from sitting for the final examination if they do not fulfil the course requirements, such as absence from lectures and tutorials of at least 70%, and have not completed/fulfilled the required components of coursework. Students will also be barred from sitting for the final examination if they have not settled the academic fees. A grade 'X' would be awarded for a course for which a student is barred. Students will not be allowed to repeat the course during the *Courses during the Long Vacation* (KSCP) period.

2.3.3 Grade Point Average System

Students' academic achievement for registered courses will be graded as follows:

Alphabetic Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Grade Points	4.00	3.67	3.33	3.00	2.67	2.33	2.00	1.67	1.33	1.00	0.67	0

Students awarded with a grade 'C-' and below for a particular course would be given a chance to improve their grades by repeating the course during the KSCP (see below) or normal semester. Students awarded with a grade 'C' and above for a particular course will not be allowed to repeat the course whether during KSCP or normal semester.

The achievement of students in any semester is based on Grade Point Average (GPA) achieved from all the registered courses in a particular semester. GPA is the indicator to determine the academic performance of students in any semester.

CGPA is the Cumulative Grade Point Average accumulated by a student from one semester to another during the years of study.

The formula to compute GPA and CGPA is as follows:

$$\text{Grade Point Average} = \frac{\sum_{i=1}^{n} U_i M_i}{\sum_{i=1}^{n} U_i}$$

where:

n	=	Number of courses taken
U_i	=	Course units for course i
M_i	=	Grade point for course i

Example of calculation for GPA and CGPA:

	Course	Unit	Grade Point (GP)	Grade (G)	Total GP
Semester I	ABC XX1	4	3.00	B	12.00
	ABC XX2	4	2.33	C+	9.32
	BCD XX3	3	1.67	C-	5.01
	CDE XX4	4	2.00	C	8.00
	EFG XX5	3	1.33	D+	3.99
	EFG XX6	2	2.67	B-	5.34
		20			43.66

$$\text{GPA} = \frac{43.66}{20} = 2.18$$

	Course	Unit	Grade Point (GP)	Grade (G)	Total GP
Semester II	ABC XX7	3	1.00	D	3.00
	ABB XX8	4	2.33	C+	9.32
	BBC XX9	4	2.00	C	8.00
	BCB X10	4	2.67	B-	10.68
	XYZ XX1	3	3.33	B+	9.99
		18			40.99

$$\text{GPA} = \frac{40.99}{18} = 2.28$$

$$\text{CGPA} = \frac{\text{Total Accumulated GP}}{\text{Total Accumulated Unit}} = \frac{43.66 + 40.99}{20 + 18} = \frac{84.65}{38} = 2.23$$

From the above examples, the CGPA is calculated as the total grade point accumulated for all the registered courses and divided by the total number of the registered units.

2.3.4 Courses During the Long Vacation *(Kursus Semasa Cuti Panjang)* (KSCP)

KSCP is offered to students who have taken a course earlier and obtained a grade of 'C-', 'D+', 'D', 'D-', 'F' and 'DK' only. Students who have obtained a grade 'X' or 'F*' are not allowed to take the course during KSCP.

The purpose of KSCP is to:

(i) Give an opportunity to students who are facing time constraints for graduation.
(ii) Assist students who need to accumulate a few more credits for graduation.
(iii) Assist "probationary" students to enhance their academic status.
(iv) Assist students who need to repeat a prerequisite course, which is not offered in the following semester.

However, this opportunity is only given to students who are taking courses that they have attempted before and achieved a grade as stipulated above, provided that the course is being offered. Priority is given to final year students. Usually, formal lectures are not held, and teaching is via tutorials.

The duration of KSCP is 3 weeks, i.e. 2 weeks of tutorial and 1 week of examination, all held during the long vacation. The KSCP schedule is available in the University's Academic Calendar.

<u>The Implementation of KSCP</u>

(i) Students are allowed to register for a maximum of 3 courses and the total number of units registered must not exceed 10.

(ii) Marks/grades for coursework are taken from the highest marks/the best grades obtained in a particular course in the normal semester before KSCP. The final overall grade is determined as follows:

Final Grade = The best coursework marks or grade +
Marks or grade for KSCP examination

(iii) GPA calculation involves the **LATEST** grades (obtained in KSCP) and also involves courses taken in the second semester and those repeated in KSCP. If the GPA during KSCP as calculated above

is 2.00 or better, the academic status will be active, even though the academic status for the second semester was probation status. However, if the GPA for KSCP (as calculated above) is 1.99 or below, the academic status will remain as probation status for the second semester.

(iv) Graduating students (those who have fulfilled the graduation requirements) in the second semester are not allowed to register for KSCP.

2.3.5 Academic Status

Active Status: Any student who achieves a GPA of 2.00 and above for any examination in a semester will be recognised as ACTIVE and be allowed to pursue his/her studies for the following semester.

Probation Status: A probation status is given to any student who achieves a GPA of 1.99 and below. A student who is under probation status for three consecutive semesters (P1, P2, FO) will not be allowed to pursue his/her studies at the university. On the other hand, if the CGPA is 2.00 and above, the student concerned will be allowed to pursue his/her studies and will remain at P2 status.

2.3.6 Termination of Candidature

Without any prejudice to the above regulations, **the University Examination Council has the absolute right to terminate any student's studies if his/her academic achievement does not satisfy and fulfil the accumulated minimum credits.**

The University Examination Council has the right to terminate any student's studies due to certain reasons (a student who has not registered for the courses, has not attended the examination without valid reasons), as well as medical reasons can be disqualified from pursuing his/her studies.

2.3.7 Examination Results

A provisional result (pass/fail) through the Campus Online portal (campusonline.usm.my) and short message service (SMS) will usually be released and announced after the School Examination Council meeting and approximately one month after the final examination.

Enquiries regarding full results (grade) can be made through the Campus Online portal and short message service (SMS). The results will be released and announced after the University Examination Council meeting and is usually two weeks after the provisional results are released.

Students can print their official semester results document namely 'SEMGRED' through the portal "*Campus Online*" (campusonline.usm.my) during the second week of the following semester.

2.4 Unit Exemption

2.4.1 Unit Exemption

Unit exemption is defined as the total number of units given to students who are pursuing their studies in USM that are exempted from the graduation requirements. Students only need to accumulate the remaining units for graduation purposes. Only passes or course grades accumulated or acquired in USM will be included in the calculation of the Cumulative Grade Point Average (CGPA) for graduation purposes.

2.4.2 Regulations and Implementation of Unit Exemption

Diploma holders from recognised Public and Private Institutions of Higher Learning:

(i) Unit exemption can only be given to courses taken at diploma level.

(ii) Courses for unit exemption may be combined (in two or more combinations) in order to obtain exemption of one course at degree level. However if the School would like to approve only one course at the diploma level for unit exemption of one course at degree level, the course at diploma level must be equivalent to the degree course and have the same number of or more units.

(iii) Courses taken during employment (in service) for diploma holders cannot be considered for unit exemption.

(iv) The minimum achievement at diploma level that can be considered for unit exemption is a minimum grade 'C' or 2.0 or equivalent.

(v) The total number of semesters exempted should not exceed two semesters.

(vi) **In order to obtain unit exemption for industrial training**, a student must have continuous work experience for at least two years in the area. If a student has undergone industrial training during the period of diploma level study, the student must have work experience for at least one year. The students are also

required to produce a report on the level and type of work performed. Industrial training unit exemption cannot be considered for semester exemption as the industrial training is carried out during the long vacation in USM.

(vii) Unit exemption for university and option courses can only be given for courses such as Bahasa Malaysia (LKM400), English Language, Islamic and Asian Civilisations and as well as co-curriculum.

IPTS (Private Institution of Higher Learning) USM Supervised/ External Diploma Graduates:

- Students who are IPTS USM supervised/external diploma graduates are given unit exemption as stipulated by the specific programme of study. **Normally, unit exemption in this category is given as a block according to the agreement** between USM (through the School that offers the programme) with the IPTS.

Students from recognised local or foreign IPTA (Public Institutions of Higher Learning)/IPTS who are studying at the Bachelor's Degree level may apply to study in this university and if successful, may be considered for unit exemption, subject to the following conditions:

i) Courses taken in the previous IPT are equivalent (at least 50% of the course must be the same) to the courses offered in USM.

ii) Students taking courses at Advanced Diploma level in IPT that are recognised to be equivalent to the Bachelor's Degree course in USM may be considered for unit exemption as in Section 2.5.

iii) The total maximum unit exemption allowed should not exceed one third of the total unit requirement for graduation.

2.4.3 Total Number of Exempted Semesters

Semester exemption is based on the total units exempted as below:

Total Units Exempted	Total Semesters Exempted
8 and below	None
9 – 32	1
33 to 1/3 of the total units for graduation	2

2.4.4 Application Procedure for Unit Exemption

Any student who would like to apply for unit exemption is required to complete the Unit Exemption Application Form which can be obtained from the Examination and Graduation Section or the respective Schools.

The form must be approved by the Dean of the School prior to submission to the Examination and Graduation Section for consideration and approval.

2.5 Credit Transfer

Credit transfer is defined as the recognition of the total number of credits obtained by USM students taking courses in other IPTAs (Public Institution of Higher Learning) within the period of study at USM, and is combined with credits obtained at USM to fulfil the unit requirements for his/her programme of study. The transferred examination results or grades obtained in courses taken at other IPTAs will be taken into consideration in the Cumulative Grade Point Average (CGPA) calculation.

(a) Category of Students Who Can Be Considered for Credit Transfer

USM full-time Bachelor Degree level students who would like to attend specific Bachelor Degree level courses at other IPTAs.

USM full-time diploma level students who would like to attend specific diploma level courses at other IPTAs.

(b) Specific Conditions

(i) Basic and Core Courses

Credit transfer can only be considered for credits obtained from other courses in other IPTAs that are equivalent (at least 80% of the content is the same) with the courses offered by the programme.

Courses that can be transferred are only courses that have the same number of units or more. For equivalent courses but with less number of units, credit transfers can be approved by combining a few courses. Credits transferred are the same as the course units offered in USM. Average grade of the combined courses will be taken into account in the CGPA calculation.

(ii) Elective or Option Courses

Students may take any appropriate courses in other IPTAs subject to permission from the School as well as the approval of the IPTAs.

The transferred credits are credits obtained from courses at other IPTAs. No course equivalence condition is required.

(iii) Minor Courses

For credit transfer of minor courses, the School should adhere to either conditions (i) or (ii), and take into account the programme requirement.

(c) General Conditions

1) The total maximum units transferred should not exceed one third of the total number of units for the programme.

2) Credit exemption from other IPTAs can be considered only once for each IPTA.

3) The examination results obtained by a student who has taken courses at other IPTAs will be taken into account for graduation purposes. Grades obtained for each course will be combined with the grades obtained at USM for CGPA calculation.

4) Students who have applied and are approved for credit transfer are not allowed to cancel the approval after the examination result is obtained.

5) Students are required to register for courses at other IPTAs with not less than the total minimum units as well as not exceeding the maximum units as stipulated in their programme of study. However, for specific cases (e.g. students on an extended semester and only require a few units for graduation), the Dean may allow such students to register less than the minimum units and the semester will not be considered for the residential requirement. In this case, the CGPA calculation will be similar to that requirement of the KSCP.

6) USM students attending courses at other IPTAs who have failed in any courses will be allowed to re-sit the examinations of the courses if there is such a provision in that IPTA.

7) If the method of calculation of examination marks in the other IPTAs is not the same as in USM, grade conversions will be carried out according to the existing scales.

8) USM students who have registered for courses at other IPTAs but have decided to return to study in USM must adhere to the existing course registration conditions of USM.

2.5.1 Application Procedure for Attending Courses/Credit Transfer

USM students who would like to apply to attend courses/credit transfer at other IPTAs should apply using the Credit Transfer Application Form.

The application form should be submitted for the Dean's approval for the programme of study at least three months before the application is submitted to other IPTAs for consideration.

2.6 Academic Integrity

"Integrity without knowledge is weak and useless. Knowledge without integrity is dangerous and dreadful." - *Samuel Johnson*

Academic honesty in academic is important because it is the main pillar in ensuring that manners and ethics with regards to high academic integrity are preserved.

Universiti Sains Malaysia encourages its students to be respectful of and to ensure that any matter relating to academic integrity will be well-preserved. Universiti Sains Malaysia always encourages its students to ensure that manners, ethics and integrity would be essential in academics while focusing on their studies in Universiti Sains Malaysia.

These are practices or acts that are considered as conducts which lack integrity in academics:

(a) Cheating

Cheating in the context of academics include copying in examinations, unauthorized use of information or other aids in any academic exercise without authorization or in a non-sincere manner. There are numerous ways and methods of cheating which include:

- Copying answers from others during a test or an exam.
- Any suspicious action that can be described as cheating or an attempt to cheat in an exam.
- Using unauthorized materials or devices without authorization (calculator, PDA, mobile phones, pager, or any smart device, and other unauthorized devices) during a test or an exam.

- Asking or allowing another student to take a test or an exam on behalf and vice-versa.
- Sharing answers or programmes for an assignments or projects.
- Purposely tampering with marked/graded after it has been returned, and then re-submitting it for remarking/regrading.
- Give command, to force, persuade, deceive or blackmail others to conduct research, do writing, programming or any task for personal gain.
- Submitting any identical or similar work in more than one course without consulting or prior permission from the lecturers concerned.

(b) Plagiarism

The reputation of an academic institution depends on the ability to achieve and sustain academic excellence through the exercise of academic integrity. Academic integrity is based on honesty, trust, fairness, respect, and responsibility, which form the basis of academic work.

One aspect of the loss of academic integrity is due to plagiarism, which is the act of presenting published and unpublished ideas, writings, works or inventions of others in written or other medium, as one's own original intellectual endeavours without any clear acknowledgement of or reference to the author of the source.

A substantial portion of academic work and research are in the written form and the university is committed in the deterrence of plagiarism.

POLICY ON PLAGIARISM OF UNIVERSITI SAINS MALAYSIA

The University Policy on Plagiarism describes USM's strong commitment to uphold academic integrity in relation to plagiarism. It will come into effect when there is an infringement of academic conduct relating to plagiarism.

This policy acts as a guideline that both educates and prevents and can be used as the basis if anyone that is part of the university violates any rules and laws of the University.

The policy applies to all students, former students, staff and former staff which include fellows, post-doctorates, visiting scholars, as well as academic, non-academic, research, contract and temporary staff who study, serving or having served, or have graduated from the University.

Plagiarism is defined as the act of presenting, quoting, copying, paraphrasing or passing off ideas, images, processes, works, data, personal words or those of other people or sources without any proper

acknowledgement, reference to or quotation of the original source(s). The acts of plagiarism include, but are not limited to, the following:

- Quoting verbatim (word-for-word replication of) works of other people.
- Paraphrasing another person's work by changing some of the words, or the order of the words, without due acknowledgement of the source(s).
- Submitting another person's work in whole or in part as one's own.
- Auto-plagiarising or self-plagiarism (one's own work or previous work) that has already been submitted previously for assessment, or for any other academic award and admitting it as newly-produced without citing the original content.
- Insufficient or misleading referencing of the source(s) that would enable the reader to check whether any particular work has indeed been cited accurately and/or fairly and thus to identify the original writer's particular contribution in the work submitted.

The University will take action of every report and offences relating to plagiarism and if the student is found guilty, the student can be charged by the university according to the Students Disciplinary Rules.

(c) Fabrication

Fabrication refers to a process of invention, adaptation or copying with the intention of cheating. This is an act of deceiving other people. Fabrication is somewhat related to matters which have been 'created' or altered.

Invention or task outcome or academic work without acknowledgement, alteration, falsification or misleading use of data, information or citation in any academic work constitutes fabrication. Fabricated information neither represent the student's own effort nor the truth concerning a particular investigation or study, and thus violating the principle of truth in knowledge. Some examples are:

- Creating or exchanging data or results, or using someone else's results, in an experiment, assignment or research.
- Citing sources that are not actually used or referred to.
- Listing with intent, incorrect or fictitious references.
- Forging signatures of authorization in any academic record or other university documents.
- Developing a set of false data.

(d) Collusion

Collusion refers to the cooperation in committing or to commit or to do work with negative intentions. Some examples of collusion include:

- Paying, bribing or allowing someone else to do an assignment, test/exam, project or research for you.
- Doing or assisting others in an assignment, test/exam, project or research for something in return.
- Permitting your work to be submitted as the work of others.
- Providing material, information or sources to others knowing that such aids could be used in any dishonest act.

(e) Other violations relating to academic integrity

- Arriving late to lecture, tutorial, class or other forms of teaching relating to their courses.
- Sending or submitting any overdue assignment relating to their courses.
- Hire someone else to do the assignment or thesis.
- Carrying out business by providing service to write assignment or thesis of the students.
- Any other violations that USM considers as violating academic integrity.

2.6.1 Consequences of Violating Academic Integrity

Students are responsible in protecting and upholding academic integrity in USM.

If in any specific event a student or students would encounter any incident that denotes academic dishonesty, the student(s) need to submit a report to the relevant lecturer. The lecturer is then responsible to investigate and substantiate the violation and report the matter to the Dean of the School.

(i) If any violation of academic integrity is considered as not of a serious nature, the Dean of the School can take administrative action on the students.

(ii) However, if the violation is deemed serious by the School, this matter will be brought to the attention of the University Disciplinary Committee for appropriate measures to be taken.

(iii) If a student is caught copying or cheating in an examination, the Investigation Committee on Copying/Cheating in Examinations will pursue the matter according to the university's procedures. If the investigation found that there is a case, the student(s) will be brought to the Secretariat of University Student Disciplinary Committee (Academic Cases) at Legal Office, Level 2, Building E42, Chancellory II, Universiti Sains Malaysia. Regarding this

matter, the Universiti Sains Malaysia (Discipline of Students) Rules will be enforced.

(iv) Measure 48 Measure Universiti Sains Malaysia (Discipline of Students) Rules provides that a student who had committed an inappropriate conduct and is found guilty could be sentenced with either or a combination of or other suitable penalty as listed:

(a) a warning ;
(b) a fine not exceeding two hundred ringgit;
(c) exclusion from any specific part or parts of the University for a specified period;
(d) suspension from being a student of the University for a specified period;
(e) expulsion from the University.

(v) Any student(s) found guilty and is to be suspended from their studies within a given duration by the University Disciplinary Committee (Academic Matters) or the University Disciplinary Committee (General Matters), the maximum suspension period will not be accounted for them in the completion of their studies and while waiting for the verdict to be read.

2.7 USM Mentor Programme

The Mentor Programme acts as a support-aid that involves staff undergoing special training as consultants and guides to the USM community who would like to share their feelings and any psychosocial issues that could affect their social activities. This programme helps individuals to manage psychosocial issues in a more effective manner, which will eventually improve their well-being in order to achieve a better quality of life.

Objectives

(a) To serve as a co-operation and mutual assistance mechanism for dealing with stress, psychosocial problems and many more in order to ensure the well-being of the USM community.

(b) To inculcate the spirit of unity and the concept of helping one another by appointing a well-trained mentor as a social agent who promotes a caring society for USM.

(c) To produce more volunteers to assist those who need help.

(d) To prevent damage in any psychosocial aspect before they reach a critical stage.

2.8 Student Exchange Programme

2.8.1 Study Abroad Scheme

The student exchange programme is an opportunity for USM students to study for one or two semesters abroad at any USM partner institutions. Ideally, students are encouraged to participate in the exchange programme within their third to fifth semester (3 year degree programme) and within the third to seventh semester (4 year degree programme).

USM students who wish to follow the SBLN programme must discuss their academic plans with the Dean or Deputy Dean of their respective Schools and also with the International Mobility & Collaboration Centre (IMCC) (to ensure that credits obtained from the external higher education institution can be transferred as part of the credit accumulation for graduation).

Any student that follows the SBLN programme and violates any disciplinary act in the external higher education institution, can be penalised in accordance with the University (Discipline of Students) Rules if the matter is referred to USM.

For further information, please visit www.imcc.usm.my or contact the International Mobility and Collaboration Centre (IMCC) at +604 – 653 2777/2774.

2.8.2 Student Exchange Programme in Local Higher Education Institutions (RPPIPT)

This is a programme that allows students of Higher Learning Institutions to do an exchange programme for a semester among the higher institutions themselves. Students can choose any relevant courses and apply for credit transfers.

USM students who want to participate in RPPIPT have to discuss their academic plans with the Dean or Deputy Dean of their respective Schools as well with the Academic Collaboration Unit, Division of Academic and International (to ensure that credits obtained from the higher education institution in Malaysia can be transferred as part of the credit accumulation for graduation).

Any student who participates in RPPIPT and violates any of the institution's displinary rules can be penalised according to the University (Discipline of Students) Rules if the matter is referred to USM.

For further information, please visit http://bheaa.usm.my/index.php/programmes/inter-university-exchange or contact the Academic Collaboration Unit of the Academic and International Division at +604 – 653 2451.

2.9 Ownership of Students' Dissertation/Research Project/Theses and University's Intellectual Property

2.9.1 Ownership of Students' Dissertation/Research Project/Theses and University's Intellectual Property

The copyright of a dissertation/research project/thesis belongs to the student. However, as a condition for the conferment of a degree, the student gives this right unconditionally, directly but not exclusively, and free of royalties to the university to use the contents of the work/thesis for teaching, research and promotion purposes. In addition, the student gives non-exclusive rights to the University to keep, use, reproduce, display and distribute copies of the original thesis with the rights to publish for future research and the archives.

3.0 UNIVERSITY REQUIREMENTS

3.1 Summary of University Requirements

Students are required to take 15 - 22 units of the following University/Option courses for University requirements:

	University Requirements	Units
1	Bahasa Malaysia	2
2	English Language	4
3	Local Students • Islamic and Asian Civilisations (TITAS) (2 Units) • Ethnic Relations (2 Units) • Core Entrepreneurship* (2 Units) International Students • Malaysian Studies (4 Units) • Option/ Bahasa Malaysia/ English Language (2 Units)	6
4	Co-curricular /Skills Courses/Foreign Language Courses/Options Students have to choose one of the following: • Co-curricular** (1-10 Units) • Skills Courses/ Foreign Language Courses/Options	3 – 12
	Total	**15 – 22**

* Students from Schools which have a similar course as this are exempted from taking this course. The units should be replaced with an option course.

** Students from the School of Educational Studies are required to choose a uniformed body co-curricular package. Registration for co-curricular courses is compulsory for students from the School of Dental Sciences (SDS). The number of co-curricular units that need to be collected is three (3) units. The breakdown is as follows: (i) 2nd year students must register for one (1) unit of the co-curricular course in semester 1. (ii) 3rd year students must register for one (1) unit of co-curricular course in semester 1 AND one (1) unit in semester 2 (further information can be obtained from the SDS Academic Office). Registration for co-curricular courses is compulsory for 1st year students from the School of Medical Sciences (SMS). The number of units that need to be collected for co-curricular courses is two (2) units. The breakdown is as follows: 1st year students must register for one (1) unit of a co-curricular course in semester 1 AND one (1) unit in semester 2 (further information can be obtained from the SMS Academic Office).

Details of the University requirements are given in the following sections.

3.2 Bahasa Malaysia

(a) Local Students

The requirements are as follows:

- LKM400/2 - Bahasa Malaysia IV

All Malaysian students must take LKM400 and pass with the minimum of Grade C in order to graduate.

Entry requirements for Bahasa Malaysia are as follows:

No	Qualification	Grade	Level of Entry	Type	Units	Status
1	(a) SPM/ MCE/ SC (or equivalent qualification) (b) STPM/ HSC (or equivalent qualification)	1 - 6 P/ S	LKM400	U	2	Graduation requirement

Note: To obtain credit units for Bahasa Malaysia courses, a minimum grade of C is required. Students may obtain advice from the School of Languages, Literacies and Translation if they have different Bahasa Malaysia qualifications from the above.

(b) International Students

- International students pursuing Bachelor's degrees in Science, Accounting, Arts (ELLS), Education (TESL), Housing, Building and Planning and English for Professionals.

All international students in this category are required to take the following courses:

Code	Type	Units
LKM100	U	2

- International students (non-Indonesian) pursuing Bachelor's degrees in Arts.

All international students in this category are required to take the following courses:

Code	Type	Units
LKM 100	Z	2
LKM 200	U	2
LKM 300	U	2

- International students (Indonesian) pursuing Bachelor degrees in Arts.

The Bahasa Malaysia graduation requirement for this category of students is as follows:

Code	Type	Units
LKM200	U	2
LKM300	U	2

Note: Students must pass with a minimum grade C for type U courses.

3.3 English Language

All Bachelor degree students must take 4 units of English Language courses to fulfil the University requirement for graduation.

(a) Entry Requirements for English Language Courses

No.	English Language Qualification	Grade	Level of Entry	Status
1	*MUET LSP401/402/403/404 † Discretion of Dean	Band 6 A - C	LHP 451/452/453/454/455/ 456/457/458/459	Compulsory/ Option/Type U (2 Units)
2	*MUET LSP300 † Discretion of Dean	Band 5 A - C	LSP 401/402/403/404	Compulsory/ Type U (2 Units)
3	*MUET LMT100 † Discretion of Dean	Band 4 A - C	LSP300	Compulsory/ Type U (2 Units)
4	*MUET † Discretion of Dean	Band 3/2/1 (Score 0 - 179)	LMT100/ Re-sit MUET	Prerequisite/ Type Z (2 Units)

* MUET: Malaysian University English Test.

† Students may obtain advice from the School of Languages, Literacies and Translation if they have different English Language qualifications from the above.

Note:

- Students are required to accumulate four (4) units of English for graduation.
- In order to obtain units in English Language courses, students have to pass with a minimum grade 'C'.
- Students with a Score of 260 – 300 (Band 6) in MUET must accumulate the 4 units of English from the courses in the post-advanced level (LHP451/452/453/454/455/456/457/ 458/459*). They can also take foreign language courses to replace their English language units but they must first obtain written consent from the Dean of the School of Languages, Literacies and Translation. (Please use the form that can be obtained from the School of Languages, Literacies and Translation).
  [*The number of units for LHP457 is 4 and for LHP451, 452, 453, 454, 455, 456, 458 and 459 is 2].
- Students with a score of 179 and below in MUET are required to re-sit MUET to improve their score to Band 4 or take LMT100 and pass with a minimum grade 'C'.

(b) English Language Courses (Compulsory English Language Units)

The English Language courses offered as University courses are as follows:

No	Code/Unit	Course Title	School (If Applicable)
1	LMT100/2	Preparatory English	Students from all Schools
2	LSP300/2	Academic English	Students from all Schools
3	LSP401/2	General English	Students from: School of Educational Studies (Arts) School of The Arts School of Humanities School of Social Sciences School of Languages, Literacies and Translation
4	LSP402/2	Scientific and Medical English	Students from: School of Biological Sciences School of Physics School of Chemical Sciences School of Mathematical Sciences School of Industrial Technology School of Educational Studies (Science) School of Medical Sciences School of Health and Dental Sciences School of Pharmaceutical Sciences
5	LSP403/2	Business and Communication English	Students from: School of Management School of Communication

No	Code/Unit	Course Title	School (If Applicable)
6	LSP404/2	Technical and Engineering English	Students from: School of Computer Sciences School of Housing, Building and Planning School of Engineering
7	LDN 101/2	English For Nursing I	Students from the School of Health Sciences
8	LDN 201/2	English For Nursing II	Students from the School of Health Sciences

3.4 Local Students - Islamic and Asian Civilisations/Ethnic Relations/Core Entrepreneurship

(a) Islamic and Asian Civilisations (The course is conducted in Bahasa Malaysia)

It is compulsory to pass the following course (with a minimum grade 'C'):

HTU 223 – Islamic and Asian Civilisations (TITAS) (2 units)

This course aims to increase students' knowledge on history, principles, values, main aspects of Malay civilization, Islamic civilization and its culture. With academic exposure to cultural issues and civilization in Malaysia, it is hoped that students will be more aware of issues that can contribute to the cultivation of the culture of respect and harmony among the plural society of Malaysia. Among the topics in this course are Interaction among Various Civilizations, Islamic Civilization, Malay Civilization, Contemporary Challenges faced by the Islamic and Asian Civilizations and Islamic Hadhari Principles.

(b) Ethnic Relations (The course is conducted in Bahasa Malaysia)

It is compulsory to pass the following course (with a minimum grade 'C'):

SHE 101 – Ethnic Relations (2 units)

This course is an introduction to ethnic relations in Malaysia. This course is designed with 3 main objectives: (1) to introduce students to the basic concepts and the practices of social accord in Malaysia, (2) to reinforce basic understanding of challenges and problems in a multi-ethnic society, and (3) to provide an understanding and awareness in managing the

complexity of ethnic relations in Malaysia. At the end of this course, it is hoped that students will be able to identify and apply the skills to issues associated with ethnic relations in Malaysia.

(c) Core Entrepreneurship (The course is conducted in Bahasa Malaysia)

It is compulsory to pass the following course (with a minimum grade 'C'):

WUS 101 – Core Entrepreneurship (2 units)

This course aims to provide basic exposure to students in the field of entrepreneurship and business, with emphasis on the implementation of the learning aspects while experiencing the process of executing business projects in campus. The mode of teaching is through interactive lectures, practical, business plan proposals, execution of entrepreneurial projects and report presentations. Practical experiences through hands-on participation of students in business project management will generate interest and provide a clearer picture of the world of entrepreneurship. The main learning outcome is the assimilation of culture and entrepreneurship work ethics in their everyday life. This initiative is made to open the minds and arouse the spirit of entrepreneurship among target groups that possess the potential to become successful entrepreneurs. By exposing all students to entrepreneurial knowledge, it is hoped that it will accelerate the effort to increase the number of middle-class entrepreneurs in the country.

For more information, please refer to the Co-curriculum Programme Reference Book.

3.5 International Students - Malaysian Studies/Option

(a) Malaysian Studies

It is compulsory for all international students to pass the following course (with a minimum grade 'C'):

SEA205E - Malaysian Studies (4 Units)

This course investigates the structure of the Malaysian system of government and the major contemporary trends in Malaysia. Emphasis will be given to the current issues in Malaysian politics and the historical and economic developments and trends of the country. The discussion begins with a review of the independence process. This is followed by an analysis of the formation and workings of the major institutions of government – parliament, judiciary, bureaucracy, and the electoral and party systems. The scope and extent of Malaysian democracy will be

considered, especially in the light of the current changes and developments in Malaysian politics. The second part of the course focuses on specific issues: ethnic relations, national unity and the national ideology; development and political change; federal-state relations; the role of religion in Malaysian politics; politics and business; Malaysia in the modern world system; civil society; law, justice and order; and directions for the future.

(b) Option/Bahasa Malaysia/English Language (2 Units)

International students need to fulfil another 2 units of an option course or an additional Bahasa Malaysia/English Language course.

3.6 Co-Curriculum/Skills Courses/Foreign Language Courses/Options

Students have to choose one of the following (A/B):

(A) Uniformed/Seni Silat Cekak/Jazz Band Co-curricular Package (6 – 10 Units)

Students who choose to take packaged co-curricular courses are required to complete all levels of the package. It is compulsory for students from the School of Education to choose a uniformed body co-curricular package from the list below (excluding Seni Silat Cekak). The co-curricular packages offered are as follows:

- Palapes (Reserve Officers' Training Corps) Co-curricular Package (10 Units) (3 years)

Palapes Army	**Palapes Navy**	**Palapes Air Force**
WTD103/3	WTL103/3	WTU103/3
WTD203/3	WTL203/3	WTU203/3
WTD304/4	WTL304/4	WTU304/4

- Co-curricular Package (6 Units) (3 years)

Suksis (Students' Police Volunteers)	**Seni Silat Cekak Malaysia**	**Jazz Band**
WPD101/2	WCC123/2	WCC108/2
WPD201/2	WCC223/2	WCC208/2
WPD301/2	WCC323/2	WCC308/2

Kelanasiswa (Rovers)	Bulan Sabit Merah (Red Crescent)	Ambulans St. John (St. John Ambulance)	SISPA (Civil Defence)
WLK102/2	WBM102/2	WJA102/2	WPA103/2
WLK202/2	WBM202/2	WJA202/2	WPA203/2
WLK302/2	WBM302/2	WJA302/2	WPA303/2

(A) Co-curricular/Skills Courses/Options (1 – 6 Units)

All students are encouraged to follow the co-curricular courses and are given a maximum of 6 units for Community Service, Culture, Sports, Innovation and Initiatives and Leadership (Students from the School of Medical Sciences and School of Dentistry are required to register for a specific number of co-curriculum units and at specific times during their academic year (Please refer to subject 3.1 Summary of University Requirements). Students from the School of Education must take the uniformed co-curricular package [excluding Seni Silat Cekak]. Students who do not enrol for any co-curricular courses or who enrol for only a portion of the 3 units need to replace these units with skills/option courses. The co-curricular, skills and option courses offered are as follows:

(i) Community Service, Culture, Sports, Innovation and Initiatives and Leadership Co-curricular Courses

Packaged (Students are required to complete all levels)			
Community Service (2 Years)	**Jazz Band (3 Years)**	**Karate (3 Semesters)**	**Taekwondo (3 Semesters)**
WKM101/2	WCC108/2	WSC108/1	WSC115/1
WKM201/2	WCC208/2	WSC208/1	WSC215/1
	WCC308/2	WSC308/1	WSC315/1
Non-Packaged (1 Semester)			
Culture		**Sports**	
WCC103/1 - Catan (Painting)		WSC105/1 - Bola Tampar (Volley Ball)	
WCC105/1 - Gamelan		WSC106/1 - Golf	
WCC107/1 - Guitar		WSC110/1 - Memanah (Archery)	
WCC109/1 - Koir (Choir)		WSC111/1 - Ping Pong (Table Tennis)	
WCC110/1 - Kraftangan (Handcrafting)		WSC112/1 - Renang (Swimming)	
WCC115/1 - Tarian Moden (Modern Dance)		WSC113/1 - Aerobik (Aerobics)	

WCC116/1 - Tarian Tradisional (Traditional Dance)	WSC114/1 - Skuasy (Squash)
WCC117/1 - Teater Moden (Modern Theatre)	WSC116/1 - Tenis (Tennis)
WCC118/1 - Wayang Kulit Melayu (Malay Shadow Play)	WSC119/1 - Badminton
WCC119/1 - Senaman Qigong Asas (Basic Qigong Exercise)	
Non-Packaged (1 Semester)	
WCC219/1 - Senaman Qigong Pertengahan (Intermediate Qigong Exercise)	WCC124/1 - Sepak Takraw
WCC124/1 - Kompang Berlagu	WSC 125/1 - Futsal
WCC122/1 - Seni Memasak (Culinary Arts)	WSC 126/1 - Bola Jaring (Netball)
WCC127/1 - Kesenian Muzik Nasyid (Nasyid Musical Arts)	WSC 128/1 – Petanque
	WSC 129/1 - Boling Padang (Lawn Bowl)
Innovation & Initiative	WSC 130/1 - Orienteering
WCC103/1 - Catan (Painting)	**Leadership (Kepimpinan)**
WCC110/1 - Kraftangan (Handcrafting)	WSC 127/1 - Pengurusan Acara 1 (Event Management 1)
WCC120/1 - Canting Batik (Batik Painting)	WSC 227/1 - Pengurusan Acara 2 (Event Management 2)
WCC121/1 - Seni Khat (Calligraphic Art)	**Public Speaking**
WCC122/1 - Seni Memasak (Culinary Arts)	WEC 101/1 – Pengucapan Awam
WCC125/1 - Seni Wau Tradisional (Traditional Kite Art)	WEC 101E/1 – Public Speaking
WCC127/1 - Kesenian Muzik Nasyid (Art of Nasheed Music)	WCC 129 – Latin Dance (Cha Cha)
WCC128/1 - Seni Sulaman & Manik Labuci (Embroidery & Beads Sequins Art)	
WCC 130/1 - Seni Fotografi SLR Digital (Digital SLR Photography Art)	
WCC/131/1 - Seni Suntingan Fotografi (Editing Photography Art)	
WCC132/1 – Seni Seramik (The Art of Ceramics)	

(ii) WSU 101/2 - Sustainability: Issues, Challenges & Prospect (2 units)

Course Synopsis

This course introduces and exposes students to the concepts of sustainable development. The course is aimed at ensuring that the ability of the next generation to fulfil their needs in the future will not be jeopardized, especially in an era of globalization that is filled with challenges and rapid advances in information technology. Sustainable development by definition, involves efforts to maintain the balance among the three important aspects, i.e. competitive economy, balanced ecosystem and social integration. For the economic aspect, it touches on the issues of development, economic growth, economic challenges of population, agriculture and industrial sector contributions, finance sector, and also information and technology. Environmental sustainability, on the other hand, focuses on forest and environmental management, marine resource management, eco-tourism, environmental degradation, natural phenomena, global warming, and also ethics in natural resource management. The social integration aspect emphasizes the role of the communities in practising sustainable development in daily life with health management, security (climate change, epidemics, crime and terrorism) and socio-economic network. Sustainable development models and case studies will be discussed too.

(iii) HTV201/2 - Teknik Berfikir (Thinking Techniques)

(iv) Other options/ skills courses as recommended or required by the respective Schools (if any)

(v) English Language Courses

The following courses may be taken as university courses to fulfil the compulsory English Language requirements (for Band 5 and Band 6 in MUET) or as skills/option courses:

No	Code/Unit	Course Title
1.	LHP451/2	Effective Reading
2.	LHP452/2	Business Writing
3.	LHP453/2	Creative Writing
4.	LHP454/2	Academic Writing

No	Code/Unit	Course Title
5.	LHP455/2	English Pronunciation Skills
6.	LHP456/2	Spoken English
7.	LHP457/4	Speech Writing and Public Speaking
8.	LHP458/2	English for Translation *(Offered only in Semester II)*
9.	LHP459/2	English for Interpretation *(Offered only in Semester I)*

(vi) Foreign Language Courses

The foreign language courses offered by the School of Languages, Literacies and Translation can be taken by students as an option or compulsory courses to fulfil the number of units required for graduation. Students are not allowed to register for more than one foreign language course per semester. They must complete at least two levels of a foreign language course before they are allowed to register for another foreign language course. However, students are not required to complete all four levels of one particular foreign language course. The foreign language courses offered are as follows:

Arabic	Chinese	Japanese	German	Spanish
LAA100/2	LAC100/2	LAJ100/2	LAG100/2	LAE100/2
LAA200/2	LAC200/2	LAJ200/2	LAG200/2	LAE200/2
LAA300/2	LAC300/2	LAJ300/2	LAG300/2	LAE300/2
LAA400/2	LAC400/2	LAJ400/2	LAG400/2	LAE400/2

French	Thai	Tamil	Korean
LAP100/2	LAS100/2	LAT100/2	LAK100/2
LAP200/2	LAS200/2	LAT200/2	LAK200/2
LAP300/2	LAS300/2	LAT300/2	LAK300/2
LAP400/2	LAS400/2		

4.0 SCHOOL OF MECHANICAL ENGINEERING

4.1 Introduction

The school of Mechanical Engineering was established on the first day of 1989. The initial main objective for the establishment of the school is to produce graduates in the field of mechanical engineering and manufacturing engineering. This is to fulfil the specialised knowledge workers required by most industries in Malaysia especially the industries that involve in design, development, manufacturing, production, service and maintenance that are related to mechanical and mechatronic goods such as devices, tools, equipments, components, machines, support system and infra-structure development.

The development of the school is also aimed to be the centre for acquiring and dissipating knowledge in the field pertaining to mechanical and manufacturing engineering. The acquisition is through the activities of research, development, project works and professional networking. The dissemination is through consultancy work, workshops, seminars and professionals writing.

For manufacturing engineering, this philosophy is achieved through a broad curriculum with emphasis on various discipline involving studies on organization and manufacturing management, manufacturing technology and manufacturing systems. In summary, this program is aimed at educating and training engineers as technologists for the manufacturing industry. The application of engineering and manufacturing principles in solving industrial problems is the main theme in this program whilst the management aspect focuses on the study on human, financial and communication factors. Similarly for mechanical engineering, the philosophy is embodied in a rigorous curriculum with emphasis fundamental knowledge in fluid, thermal, electrical and mechanics of materials, mechanical system principles and design and engineering analysis involving of mechanical systems.

The School of Mechanical Engineering offers engineering academic qualifications at Bachelor, Master and Philosophical Doctorate levels. For Bachelor Engineering degree, the School offers two (2) honours degree programmes that are:

1. Bachelors of Mechanical Engineering (honours)
2. Bachelors of Manufacturing Engineering with Management (honours)

The post-graduate programmes at the school specialise in the areas of Applied Mechanics, Thermo-fluid, Manufacturing Technology, Manufacturing System and Manufacturing Management.

4.1.1 Outcome Based Education (OBE)

Starting from the 2006/2007 Academic Session, the OBE practice has been adopted in the teaching and assessment of all Engineering Degree Programmes at the School of Mechanical Engineering. The implementation of the OBE emphasises on the definite objective of the attributes of the graduates to be produced by the programme. In this relation, the development of Programme Educational Objective (PEO) has incorporated the input from all stakeholders, which include industries, government, parents, alumni, students and lecturers. Thus the following PEO have been set:

Program Educational Objectives

(1) Excel in engineering practices in various industries
(2) Establish themselves as leaders in their professional careers
(3) Earn an advanced degree or professional certification

In relation to the PEO, a set of Program Outcome (PO) has been formulated to ensure that the program curriculum is aligned with the mentioned attributes in the PEO. Therefore the Engineering Degree Programmes at the School of Mechanical Engineering has been developed and monitored to successfully produce engineer with the following qualities, skills and characters:

Program Outcomes

Upon graduation, the graduates from the engineering programmes offered by the School of Mechanical Engineering should be able to

(1) Apply knowledge of mathematics, science and engineering fundamentals to solve complex engineering problems particularly in mechanical and manufacturing engineering.
(2) Identify, formulate and analyze complex engineering problems to an extent of obtaining meaningful conclusions using principles of mathematics, science and engineering.
(3) Design solutions for complex engineering problems and design systems, components or processes to within the prescribed specifications relevant to mechanical and manufacturing engineering with appropriate considerations for public health and safety, society and environmental impact.
(4) Investigate complex mechanical and manufacturing engineering problems using research-based knowledge and research methods to provide justified conclusions.
(5) Create, select and apply appropriate techniques, resources, and modern engineering and computational tools to complex engineering activities with an understanding of the limitations.
(6) Apply appropriate reasoning to assess contemporary societal, health, safety and legal issues to establish responsibilities relevant to professional engineering practice.

(7) Demonstrate the knowledge of and need for sustainable development in providing professional engineering solutions.
(8) Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
(9) Communicate effectively both orally and in writing on complex engineering activities with the engineering community and society.
(10) Function successfully and efficiently as an individual, and as a member or leader in multi-disciplinary teams.
(11) Recognize the need for, and is capable to undertake life-long learning in the broadest context of knowledge and technological change.
(12) Apply knowledge and understanding of project management and finance to engineering projects.

4.1.2 Bachelor of Mechanical Engineering (Honours)

Mechanical Engineering Program at USM is designed to prepare the student to fulfil the needs in engineering as a career in a wide spectrum of field in mechanical engineering. The program emphasises on design, numerical analysis and simulation, infrastructure and machinery developments, management and maintenance of mechanical engineering related field for fulfilling the needs of modern living. The program also emphasise on inter disciplines involving various field of engineering, i.e. electrical & electronic, material & mineral resources, chemical, civil and aerospace. The mechanical engineering profession also involves the manufacturing of goods with functional efficiency, full utilization of resources that are economical and reliable. They also involve with the development activities of multiple types of modern equipment such as gas turbine, oil rig and piping, engines or machines, mechanical components, innovation of end-user products, medical equipments and equipments of food processing industries.

Generally, the Mechanical Engineering program can be classified into four main sub areas:

Applied Mechanics
Engineering Mechanics, Statics, Strength of Materials, Solid Mechanics, Dynamic & Mechanism, Noise & Vibration, Applied Finite Element Analysis (FEA), Stress Analysis, Structural Impact and Composite Structures.

Thermofluids
Fluid Mechanics, Thermodynamic, Fluid Dynamics, Applied Thermodynamic, Heat Transfer, Numerical Method for Engineers, Computational Fluid Dynamics, Internal Combustion Engine, Refrigeration & Air-Conditioning and Energy Conversion System.

System and Manufacturing Technology, Measurements and Control
Manufacturing Technology, Measurement, Instrumentation, Metrology, Quality Control, Industrial Engineering, Robotics, Automation and Industrial Machine Vision.

Design and Laboratory

Engineering Drawing, Engineering Practices, Conceptual Design and Computer Aided Design, Component and Machine Design, System Design, Engineering Laboratory and Final Year Project.

The Mechanical Engineering program also incorporates the non-technical subjects such as management, economy and communication skills that needed for engineer. The program also prepares the student to be ready for the post graduate programmes via the project and independent type of learning style. Most of the elective courses are also designed to equip the students with the necessary knowledge for research work in MSc and PhD.

4.1.3 Bachelor of Manufacturing Engineering with Management (Honours)

The programme was introduced in 1999 with initial intake of 40 students. For effective teaching and learning, this small number of less than 40 is maintained, even after the APEX University intake in 2009/2010.

Manufacturing Engineering at USM is designed to prepare competent engineering graduates employable in wide spectrum of manufacturing industries. The programme delivers fundamental knowledge and skills in manufacturing science, manufacturing process and technology, industrial automation, industrial ergonomic and quality control, materials processing, product design and development, and management of the whole production chain.

The management of cost, quality, efficiency and human factors involving a manufacturing system is taught through a series of production management, engineering economic and ergonomic courses. The scientific and technical aspects of manufacturing are mainly emphasized in a group of manufacturing technology, processes, metrology and control courses. With the combination of technical skills and managerial knowledge required of a modern manufacturing system, the Manufacturing Engineering with Management programme produces engineers who are able to manage effectively and efficiently the limited resources, equipment and manpower for the manufacture of high value goods.

In addition to the common engineering courses, Manufacturing engineering courses and programme delivery covers the following area of technical competencies.

Product/System Design and Laboratory
Engineering drawing, computer aided design/computer aided manufacturing, design for manufacturing, tooling design, manufacturing systems design, engineering workshop skills, basic manufacturing laboratory, advanced [open ended] manufacturing laboratory, research skills [final year project], industrial exposure [industrial training].

Manufacturing Technology, Processes and Recent Topics
Fundamental manufacturing processes including welding, casting, metal machining, shaping, forming, bending, ceramic, glass, plastic and composite processing, non-traditional machining, semi-conductor manufacturing, rapid prototyping and tooling, lithography, micro/nano scale fabrication techniques.

Applied Manufacturing Sciences
Manufacturing process, technology and systems, ergonomics, quality control, measurement and instrumentation, metrology, automation and control, machine vision and image processing.

Production and Manufacturing Systems Management
Management of production systems, assembly cells design and balancing, logistic and resource allocation, manufacturing systems optimization, human factor in manufacturing, engineering economy and costing.

4.2 Philosophy and Objective

General goals of these undergraduate engineering programmes are to produce mechanical and manufacturing graduates having high professional status that can be employed directly to the industries, government departments or statutory bodies. Exposure to the latest technologies and applications of sophisticated equipment and facilities in solving engineering problems will ensure that the Mechanical Engineering and Manufacturing Engineering with Management graduates from the School of Mechanical Engineering will possess a high level of professional status. Apart from that, they will be trained to become responsible engineers towards their profession, the nation and the environment.

4.3 Main Administrative Staff

Prof. Dr. Zainal Alimuddin Zainal Alauddin
Dean

Assoc. Prof. Dr. Jamaluddin Abdullah
Deputy Dean
[Academic, Student & Alumni]

Prof. Dr. Mani Maran A/L Ratnam
Deputy Dean
[Research, Graduate & Networks]

Dr. Mohamad Yusof Idroas
Program Chairman
[Mechanical Engineering]

Assoc. Prof. Dr. Ahmad Baharuddin Abdullah
Program Chairman
[Manufacturing Eng. with Management]

Assoc. Prof. Dr. Khairudin Mohamed
Coordinator
[Business Unit]

Mr. Md Kamal Shari Pinansa
Senior Assistant Registrar

4.4 List of Academic Staff

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4.5 Industry/Community Advisory Panel (ICAP)

Pn. Maziah Mohamad
Director
Sri Jentayu Sdn. Bhd
Wangsa Maju, Kuala Lumpur

Ir. Dr. Mui Kai Yin
Director
PMO Asia Sdn. Bhd.
Tanjung Bungah, Pulau Pinang

En. Nazry Murat
HR Manager
Convatec Medical Devices
Sungai Petani, Kedah

En. Lim Yew-Kee
Vice President
Tauhop Solutions (Pulau Pinang)
Bayan Lepas, Pulau Pinang

En. Mohd Kamaldin Nordin
HR Director
Bose Systems Malaysia Sdn. Bhd.
Simpang Ampat, Pulau Pinang

4.6 Laboratories Facilities

In addition to the facilities for the basic and general teaching of engineering, the School of Mechanical Engineering also has modern and sophisticated equipments for teaching as well as research. It ensures a complete engineering education that is significant to the industries, is inclusively provided to the students. Among the laboratory facilities in the School are:

1. Aerodynamic Laboratory
2. Heat Transfer Laboratory
3. Energy Conversion Laboratory
4. Engine Laboratory
5. Applied Mechanic Laboratory
6. Proton-USM Research & Design Centre
7. Vibration Laboratory
8. Metrology & Precision Engineering Laboratory
9. Manufacturing Process Laboratory
10. Failure Analysis Laboratory
11. Lithography Laboratory
12. Computer Aided Design and Manufacturing Laboratory
13. Electron and Optical Microscopies Laboratory
14. Nanofabrication and Functional Materials Laboratory
15. Materials Characterisation Laboratory
16. Agilent Technologies Instrumentation Laboratory
17. Robotic Laboratory
18. Automation Control Laboratory
19. Bioenergy Laboratory
20. Forging Laboratory
21. CNC Machining/Rapid Prototyping
22. Machine Shop I [Milling]

23. Machine Shop II [Lathe]
24. Fitting Shop
25. Welding Shop

4.7 Job Opportunities

Graduates from Mechanical Engineering and Manufacturing Engineering with Management Programmes have wide job opportunities in all aspects of technology and management of various industries and organizations such as manufacturing industries, automotive industries, electrical and electronic industries, construction industries, research organization, consultants and research institution and universities.

Career of Manufacturing Engineering includes design engineer, process engineer, maintenance engineer, project engineer, plant engineer, quality control engineer, managers, researchers, teachers etc.

4.8 Post Graduate Studies and Research Programme

School of Mechanical Engineering offers Postgraduate Studies by Research in various fields of Mechanical Engineering and Manufacturing Engineering for the Degree of M.Sc. and Ph.D. Both these programmes are offered either full time or part time. The School of Mechanical Engineering has formed research units as research thrusts to spear head research in the field of Mechanical Engineering and Manufacturing Engineering including:

Energy

Energy Resources - Biomass
Energy Conversion Technologies
Internal Combustion Engine
Alternative Fuel Combustors
Gas Turbine, Incinerators
Aerofoil, Flow in Passages, Micro Flow Sensor, Two Phase Flow

Bio-Engineering & Applied Mechanics

Experimental and Numerical Stress Analysis
Dynamic Characteristics of Materials
Instrumentation and Automatic Control
Structural Optimization
Noise and Vibration
Impact Studies and Fracture Mechanics
Experimental Mechanics

Manufacturing System & Automation

Design for Manufacture and Assembly
Industrial Automation
CAD/CAM and Reverse Engineering
Manufacturing System Design and Analysis

Manufacturing Planning and Control
Technology Management
Machine Vision & Metrology

Manufacturing Processes

Advanced Manufacturing Process
Laser Applications
Rapid Prototyping & Tooling
CNC Machine
Tool and Die
Casting

Industrial Engineering

Ergonomics
Quality & Reliability
Artificial Intelligence in Manufacturing
Productivity Engineering Facilities Planning &
Design
Process Optimization
Production Planning & Control
Value Engineering and Project Management

Aerospace Engineering

Aerodynamics
Computational Fluid Dynamics (CFD)
Flow Control
Numerical Techniques
Compressible Flow
High Performance Computing (HPC)
Mechanics of Composite Materials
Stress & Failure Analysis of Structures
Aeronautical Structure & Composite Material in Aircraft Application
Experimental Fluid Dynamics
Satellite System
Control, Robotics and Automation

Nanofabrication and Functional Materials

Nano Engineering (Nano Science, Engineering and Technology)
Nanofabrication
Lithography Techniques
Nanodevices
Thin Films
Functional Materials
Shape Memory Alloys
Coating and Surface Engineering

4.9 Program for Bachelor of Mechanical Engineering [Honours]

Type of course	Category	Level 100				Level 200				Level 300				Level 400			
		Semester 1	Semester Break	Semester 2	Long Vacation	Semester 1	Semester Break	Semester 2	Long Vacation	Semester I	Semester Break	Semester 2	Long Vacation	Semester 1	Semester Break	Semester 2	Unit
CORE	Thermofluids			EMH 102/3 Fluid Mechanics		EMH 211/3 Thermo-dynamics		EMH 222/3 Fluids Dynamics		EMH 332/3 Applied Thermo-dynamics				EMH 441/3 Heat Transfer			
	Applied Mechanics			EMM 102/3 Statics		EMM 213/3 Strength of Materials		EMM 242/2 Dynamics		EMM 331/3 Solid Mechanics		EMM 342/3 Noise and Vibrations					
	Design	EMD 101/2 Engineering Drawing		EMD 112/2 Conceptual Design and CAD				EMD 223/2 Machine Component Design				EMD 332/2 Machine Design		EMD 431/4 Mechanical Engineering Integrated Design EMD 452/2 Final Year Project		EMD 452/4 Final Year Project	
	Laboratory	EML 101/2 Engineering Practice				EML 211/2 Engineering Laboratory I				EML 331/2 Engineering Laboratory II		EML 342/2 Engineering Laboratory III					
	Measurement/ Control	EEU 104/3 Electrical Technology		EMT 101/2 Numerical Computing		EMC 201/3 Measurement and Instrumentation		EPM 212/3 Metrology and Quality Control		EMC 311/3 Mechatronic		EMC 322/3 Automatic Control					
	Manufacturing	EBB 113/3 Engineering Materials				EPP 201/3 Manufacturing Technology I				EPP 331/3 Manufacturing Technology II		EPM 332/3 Industrial Engineering					
	Mathematic/ Computing	EUM 113/3 Engineering Calculus		EUM 114/3 Advanced Engineering Calculus		EMT 211/3 Engineering Probability & Statistics		EMT 212/3 Computational Engineering				EMT 302/3 Mathematical Modelling in Engineering				EUP 222/3 Engineers in Society	
		13		13		17		15		15		16		7		7	**108**
University Requirement		Malay Language (2 units)		Core Entrepreneurship (2 units)		English Language (2 units)		Ethnic Relation (2 units)		English Language (2 units)		Co-curriculum (3 units)					**15**
								Islamic & Asean Civilisations (2 units)									

E L E C T I V E	**Thermofluids**													EME 431/3 Refrigeration and Air Conditioning		EME 422/3 Energy Conversion System EME 432/3 Internal Combustion Engines	
	Manufacturing/ Measurement Control													EPC 431/3 Robotic and Automation EPE 462/3 Industrial Machine Vision		EPE 482/3 Optical and Surface Metrology	
														EME 411/3 Numerical Methods for Engineers		EME 401/3 Applied Finite Element Analysis	
	Computational Methods													EME 451/3 Computational Fluid Dynamics			
	Total Unit																**12**
	Grand Total Unit																**135**

Note: University Requirement 15 units
Elective 12 units

4.9.1 Curriculum

LEVEL 100

			Units		
			Total	Lectures	Lab
SEMESTER I					
EMD	101/2	Engineering Drawing	2	0	2
EML	101/2	Engineering Practice	2	0	2
EEU	104/3	Electrical Technology	3	3	0
EBB	113/3	Engineering Materials	3	3	0
EUM	113/3	Engineering Calculus	3	3	0
			13	**9**	**4**
SEMESTER BREAK					
SEMESTER II					
EMT	101/2	Numerical Computing	2	1	1
EMH	102/3	Fluids Mechanics	3	3	0
EMM	102/3	Statics	3	3	0
EMD	112/2	Conceptual Design and CAD	2	0	2
EUM	114/3	Advanced Engineering Calculus	3	3	0
			13	**10**	**3**
LONG VACATION (13 weeks)					

LEVEL 200

			Units		
			Total	Lectures	Lab
SEMESTER I					
EMC	201/3	Measurement & Instrumentation	3	2	1
EPP	201/3	Manufacturing Technology I	3	3	0
EML	211/2	Engineering Laboratory I	2	0	2
EMH	211/3	Thermodynamics	3	3	
EMT	211/3	Engineering Probability & Statistics	3	3	0
EMM	213/3	Strength of Materials	3	3	0
			17	**14**	**3**
SEMESTER BREAK					
SEMESTER II					
EMT	212/3	Computational Engineering	3	3	0
EPM	212/3	Metrology and Quality Control	3	3	0
EMH	222/3	Fluids Dynamics	3	3	0
EMM	242/2	Dynamics	2	2	0
EMD	223/2	Machine Component Design	2	1	1
			13	**12**	**1**
LONG VACATION (13 weeks)					

LEVEL 300

			Units		
			Total	Lectures	Lab
SEMESTER I					
EMC	311/3	Mechatronic	3	1.5	1.5
EML	331/2	Engineering Laboratory II	2	0	2
EMM	331/3	Solid Mechanics	3	3	0
EPP	331/4	Manufacturing Technology II	4	4	0
EMH	332/3	Applied Thermodynamics	3	3	0
			15	**11.5**	**3.5**
SEMESTER BREAK					
SEMESTER II					
EMT	302/3	Mathematical Modelling in Engineering	3	3	0
EMC	322/3	Automatic Control	3	3	0
EMD	332/2	Machine Design	2	0	2
EPM	322/3	Industrial Engineering	3	3	0
EML	342/2	Engineering Laboratory III	2	0	2
EMM	342/3	Noise and Vibrations	3	3	0
			16	**12**	**4**
LONG VACATION (13 weeks)					
EML 451/5 – Industrial Training (10 weeks)					

LEVEL 400

			Units		
			Total	Lectures	Lab
SEMESTER I					
EMH	441/3	Heat Transfer	3	3	0
EMD	431/4	Mechanical Engineering Integrated Design	4	0	2
EMD	452/2	Final Year Project	2	0.5	1.5
			9	**3.5**	**5**
Elective					
EPC	431/3	Robotic and Automation	3	2.5	0.5
EME	411/3	Numerical Methods for Engineers	3	3	0
EME	431/3	Refrigeration and Air Conditioning	3	3	0
EME	451/3	Computational Fluid Dynamics	3	3	0
EPE	462/3	Industrial Machine Vision	3	3	0
			15	**14.5**	**0.5**
SEMESTER BREAK					
SEMESTER II					
EUP	222/3	Engineers in Society	3	3	0
EMD	452/4	Final Year Project	4	0	4
			7	**3**	**4**
Elective					
EME	401/3	Applied Finite Element Analysis	3	3	0
EME	422/3	Energy Conversion System	3	3	0
EME	432/3	Internal Combustion Engines	3	3	0
EPE	482/3	Optical and Surface Metrology	3	3	0
			12	**12**	**0**
LONG VACATION (13 weeks)					

4.9.2 Course – Programme Outcome Matrix

		Program Outcomes											
Level 100	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EMD 101-Engineering Drawing	1					√				√			
EML 101-Engineering Practices	1					√			√				
EUM 113 – Engineering Calculus	1	√	√										
EEU104 - Electrical Technology	1	√	√										
EBB 113 - Engineering Materials	1	√											
EMH 102- Fluid Mechanics	2	√	√										
EMM 102-Statics	2	√	√										
EMD 112-Conceptual Design and CAD	2		√	√		√				√			
EPM 102- Engineering Economy	2	√	√										√
EMT 101- Numerical Computing	2	√	√	√		√							
EUM 114 – Advanced Engineering Calculus	2	√	√										
Level 200	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EMT 211 - Engineering Probability and Statistics	1	√	√										
EMH 211-Thermodynamics	1	√	√										
EMM 213-Strength of Materials	1	√	√										
EML 211-Engineering Laboratory I	1	√			√					√	√		
EMC 201-Measurement System and Instrumentation	1	√	√										
EPP 201-Manufacturing Technology I	1	√	√					√					
EUP 222 - Engineers in Society	1	√		√			√		√		√		√
EPP 212-Advanced Manufacturing Technology	2		√	√		√							
EMM 242-Dynamics	2	√	√										
EPD 212 - Product Design & Development	2	√		√		√					√		
EPM 212- Metrology and Quality Control	2		√							√		√	
Level 300	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EMC 311-Mechatronics	1	√		√		√							
EPD 321- Design for Manufacturing	1		√	√						√	√		
EPM 321- Manufacturing System	1		√	√						√			
EPP 322-Advanced Manufacturing Processes	1		√		√			√					
EPM 311 - Engineering Management	1	√									√		√
EPL 322 - Manufacturing Laboratory I	2	√	√		√	√				√	√		
EPM 342-Production Management	2		√	√				√					
EPD 332-Tooling Design	2			√		√		√		√			√
EMC 322-Automatics Control	2			√	√								
EPM 322-Industrial Engineering	2			√			√						√
Level 400	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EPL 431 - Manufacturing Laboratory II	1	√	√		√	√				√	√		
EPM 451-Computer Integrated Manufacturing	1			√			√		√				
EPC 431-Robotics and Automation	1	√		√		√							
EPD 452-Final Year Project	1 & 2		√	√	√	√			√	√	√	√	
EPD 442 -Manufacturing Engineering Integrated Design	2	√	√		√	√	√		√	√	√		√
Elective Courses	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EPE 421-Ergonomik and Industrial Safety	1						√		√	√			
EPE 431-Project Management	1					√						√	√
EPE 432-Lean Six Sigma Manufacturing Management	2		√	√					√	√			
EPE 462-Industrial Machine Vision	1		√			√							
EPE 441 - Micro and Nano-Manufacturing Engineering	1				√		√		√				
EPE 442 - Advanced Semiconductor Manufacturing Technology	2			√				√				√	
EPE 401-Artificial Intelligence in Manufacturing	2		√	√		√							
EPE 482-Optical and Surface Metrology	2	√	√			√				√			

4.9.3 Course Description

EMM 101/3 – Engineering Mechanics
(Not offered for Mechanical Student)

Objective: To provide students with the fundamental concepts and principles of rigid bodies in statics and dynamics equilibrium.

Synopsis: This course is an introduction to the mechanics of rigid bodies. It is divided into two areas: Statics and Dynamics. In Statics, the student will learn the fundamental concepts and principles of rigid bodies in static equilibrium. In Dynamics, the student will learn the fundamental concepts and principles of the accelerated motion of a body (a particle). Consideration is given on the fundamental of mechanics and structure analysis, including concepts of free body diagram as well as force, moment, couples, kinematic of motion, momentum, impulse, conservation of energy and equilibrium analyses in two and three dimensions.

Course Outcome:

1. Able to identify and resolve force magnitudes and vectors into components.
2. Able to describe and draw the free-body diagram and to solve the problems using the equations of equilibrium.
3. Able to define the system of forces and moments and calculate the resultants of force using the concept of equilibrium system.
4. Able to identify and calculate the centroid, centre of gravity and area moment of inertia
5. Able to describe the motion of a particle in terms of kinematics
6. Able to apply equation of motion in solving dynamics problems
7. Able to apply the principles of energy and momentum in solving dynamics problems

References:

1. R.C. Hibbeler, Engineering Mechanics: Statics and Dynamics, 11th ed., SI Units Prentice Hall, 2007.
2. J. L. Meriam and L.G. Kraige, Engineering Mechanics: Statics and Dynamics, 4th ed., Wiley, 1998.
3. F.P. Beer and E.R. Johnston Vector, Mechanics for Engineers: Statics and Dynamics, 7th ed., SI Units, Mc Gawk Hill, 2004.

EMD 101/2 – Engineering Drawing

Objective: To introduce the technique of engineering graphics as a basis of engineering communication and expression of idea and thought. It consists of the principles and perspectives of geometric drawing that includes the standardization, drafting, dimensions and etc.

Synopsis: An introductory course in the engineering graphics comprises of the application of the principles of geometric drawing and perspective as a preparation for engineering drawings course. Topics include: standards in engineering drawings, freehand sketching, dimensioning and tolerance, engineering drawing practice including the use of standards and conventional representation of machine elements and assembly drawings, and introduction to computer aided drafting.

Course Outcome:

1. Able to use proper and standard technique in lettering, basic geometric constructions, sketching, dimensioning methods to describe size, shape and position accurately on an engineering drawing.
2. Able to create orthographic projection auxiliary, sectional views, and apply 3D pictorials to choose the best view to present the drawings.
3. Able to produce final drawings during the design process including assembly, machine and working drawings.
4. Able to create 3D part and assembly drawings using CAD software.

References:

1. B.H. Amstead, Ostwald, F. Philip, Begemen, L. Myrm, Manufacturing Processes, John Wiley and Sons, 1987.
2. P.C. Barr, CAD: Principles and Application, Englewood Cliff N.J, Prentice-Hall, 1985.
3. British Standard BS 308; Parts 1-3, London: British Standard Institution, 1984.

EML 101/2 – Engineering Practice

Objective: To provide the exposure and basic knowledge of hands-on engineering practices that includes the academic aspects as well as practical trainings in learning and teaching of common engineering workshop works and also to optimize the use of available resources in the laboratory.

Synopsis: Trainings are based on theoretical and practical concepts which consists of manufacturing process; computer numerical control (CNC), lathe, mill and thread machining, joint process, arc welding, gas welding and MIG welding, metrology measurement, electric and electronic circuits, and safety practice in laboratory and workshop.

Course Outcome:

1. Able to comply with the workshop procedures and safety regulation.
2. Able to identify and to use common engineering tools in proper and safe manners.
3. Able to produce engineering work-piece using the correct tools and equipments within the time allocated.
4. Able to carry out accurate engineering measurement and label the dimensions and tolerance.

5. Able to select the optimum tools, equipments and processes in producing the work-piece.

References:

1. J.J. Child, An Introduction to CNC Machining, Cassell Computing, 1984.
2. S. Kalpakjan, Manufacturing Engineering and Technology, 3rd ed., Addison Wesley, 1995.
3. Ibrahim Che Muda dan Ramudaram, Teknologi Bengkel Mesin, 1995.
4. Ahmad Baharuddin Abdullah, Modul Kerja Amalan Kejuruteraan, 2005.

EEU 104/3 – Electrical Technology
(Offered by the School of Electrical Engineering)

Objective: To study characteristics of various elements of electrical engineering and analyze the electrical circuits and magnetic devices

Synopsis: **Units, Definitions, Experimental Laws and Simple Circuits**
System of units, charge, current, voltage and power types of circuits and elements. Ohms law, Kirchhoff's laws, analysis of a single-loop current, single node-pair circuit, resistance and source combination, voltage and current division.

Circuit Analysis Techniques
Nodal and mesh analyses, linearity and Superposition, source transformations, Thevenin's and Norton's theorems.

Inductance and Capacitance
The V-I relations for inductor and capacitor, inductor and capacitor combinations, duality, linearity and its consequences.

Source-free Transient Response of R-L and R-C Circuits
Simple R-L and R-C circuits,exponential response of source free R-L, R-C circuits.

Response to Unit Step Forcing Function
Response of R-L, and R-C circuits to unit step forcing functions.

Response to Sinusoidal Forcing Function.
Characteristics of sinusoidal forcing functions, response of R-L and R-C circuits to sinusoidal forcing functions.

Phasor Concept
The complex forcing function, the phasor, phasor relation-ships for R,L, and C, impedance and admittance.

Average Power And RMS Values
Instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power.

Power System Circuits
An overview of single and three phase systems, wye and delta configurations of three circuits, wye and delta transformations, and power calculations in three phase systems.

Magnetic Circuits and Devices
Concept and laws of magnetism and analysis of transformers. Introduction to electromechanical energy conversion, operation of machines as generators and motors, power loss, efficiency and operations at maximum efficiency.

Course Outcome:

1. To be able to identify basic quantity and unit definitions.
2. To be able to define the basic of electrical.
3. To be able to comprehend the principle of DC, AC and transient circuit analysis.
4. To be able to encapsulate the principle of magnetic device, magnetic circuit, and transformer.

References:

1. Alexander and Sadiku, "Fundamentals of Electric Circuits", 3rd ed., Mc Graw Hill, 2007.
2. Huges, "Electrical and Electronic Technology" 10th ed., Pearson Prentice Hill, 2008.
3. Nilsson and Riedel, "Electric Circuits", 8th ed., Pearson Education, 2008.

EBB 113/3 – Engineering Materials
(Offered by the School of Materials and Minerals Engineering)

Objective: Students are expected to acquire the fundamental knowledge on engineering materials especially on the classification of materials, properties and applications.

Synopsis: The course is an introductory course on engineering materials which is divided into two main parts. The first part includes the classifications of engineering materials that determine their applicability, the structure of the materials explained by bonding scheme of different materials, the structure of crystalline solids and introduction to imperfection in solids and diffusion mechanism. The first part also includes the introduction of phase diagram. The second part covers the behaviors and characteristics of engineering materials including mechanical and electrical properties.

In general, this introductory materials science and engineering course deals with the different material types (i.e., metals, ceramics, polymers, composites), as well as the various kinds of properties exhibited by these

materials (i.e., mechanical, electrical, magnetic, etc.) which intended to equip the students with necessary knowledge on material science and engineering.

Course Outcome:

1. Able to define different classes of engineering materials.
2. Able to explain the electronic structure of individual atom as well as inter-atomic bonding and crystal structure of solids.
3. Able to differentiate the types of imperfections and diffusion mechanism.
4. Able to interpret the phase diagram and phase transformation.
5. Able to explain thermal, optical, electrical and magnetic properties of materials.

References:

1. **Text book**
   Materials Science and Engineering: An Introduction, W.D. Callister & D.G. Rethwisch, 9th edition, Wiley, 2013.
2. **Reference books**
   (i) The Science and Engineering of Materials, Donald R. Askeland, Pradeep P. Phulé, Chapman & Hall, 5th edition, Thomson Leaning, 2006, USA.
   (ii) Foundations of Materials Science and Engineering, 4thEdition, William F. Smith, William Smith, McGraw Hill, 2006, New York.
   (iii) Introduction to Materials Science for Engineers, 7th Edition, James F. Shackelford, Prentice Hall, 2008, New Jersey

EUM 113/3 - Engineering Calculus
(Offered by the School of Electrical Engineering)

Objectives: This course reviews the concept of one and multivariable calculus and covers the concept of ordinary differential equation. This course will provide students with a variety of engineering examples and applications based on the above topics.

Synopsis: **Calculus of One Variable**

Concept of Function: domain and range, limit and continuity, L'Hopital Rule.
Differentiation: mean theorem concept, techniques of solutions and applications.
Integration: Riemann sum concept, techniques of solutions and applications.
Solution of Numerical Method
Newton Raphson, Simpson

Calculus of Multivariable

Multivariable Function: scalar and vector, operator with vector function, limits and continuity.
Partial Differentiation: chain rule, derivatives differential and vector slope, maximum and minimum values, Lagrange multiplier.
Multiple Integration: Double integration and its application, triple integration and its applications, change of variables in multiple integration.

Ordinary Differential Equations

Solution of First Order ODE: separation of variables, linear, Bernoulli, exact, non exact, homogenous, non homogenous.
Solution of Second Order ODE:
Homogenous linear with constant coefficients
Non Homogenous linear with constant coefficients: method of undetermined coefficient, operator D, variation of parameter.
Euler Cauchy equation.
Solution of ODE using: Laplace Transform and numerical method (Euler)

Course Outcome:

1. Able to define the concept and solve the problem of one and multivariable calculus.
2. Able to define the concept of ODE and recognize different methods for solving ODE.
3. Able to use the analytical and numerical methods to solve ODE problems.
4. Able to apply the above concepts for solving engineering problems.

References:

1. Glyn J., (2010).Modern Engineering Mathematics, 4th Edition Pearson
2. Glyn, J., (2010). Advanced Modern Engineering Mathematics, 4th Edition. Pearson
3. Silvanum P.Thompson, Martin Gardner (2008). Calculas Made Easy, Enlarge Edition. Johnston Press
4. J.N.Sharma. (2007). Numerical Method for Engineers, 2nd Edition. Alpha Science
5. Smith R. T. and Minton, R., (2008), Calculus, 3rd Edition, Mc Graw Hill.
6. Ramana, B.V (2007). Higher Engineering Mathematics, 1st Edition, Tata Mc Graw Hill
7. O'Neil, P.V., (2007). Advanced Modern Engineering Mathematics, 1st Edition.
8. Kreiyzig, E., (2010). Advanced Engineering Mathematics,10th Edition.Wiley.Thomson
9. Stroud, K.A, Dexter. J.Booth(2007). Engineering Mathematics, 6th. Edition.Industrial Press
10. James Stewart (2011). Calculus,7th Edition, Brooks cole
11. James Stewart (2011).Multivariable Calculus,7th Edition, Brooks Cole

12. Ron Larson,Bruce H. Edwards (2009). Calculus, 9th Edition. Brook Cole.
13. Steven Chapra, Raymond Canale (2009). Numerical Method for Engineers, 6th Edition. Mc Graw Hill
14. D.Vaughan Griffith,I.M Smith (2006). Numerical Method for Engineers, 2nd Edition. Chapman and Hall.

EMT 101/2 – Numerical Computing

Objective: An introduction to engineering programming, problem solving and algorithm developing using programming language.

Synopsis: This course covers the fundamental concepts of programming, introduction to programming language, control structures and operators, arrays and plots and data file processing. Mathematical problem application will be demonstrated.

Course Outcome:

1. Able to declare and manipulate data types for a simple C++ programming.
2. Able to determine inputs and outputs in programming.
3. Able to manipulate arrays in programming.
4. Able to use a control structure in solving problems.
5. Able to plan and develop a program with algorithms and pseudocode.

References:

1. Chapman, S.J., Matlab Programming for Engineers. Toronto: Thompson. (Latest Edition)
2. Chapra S.C. and Canale, R. P., Numerical Methods for Engineers. New York, McGraw-Hill (Latest Edition)
3. Prata S., C++ Primer Plus. 5th Edition. SAMS Publishing. Indiana (2005)
4. Overman, E., A Matlab Tutorial. Avaliable at: http://www.math.osu.edu/~overman.2/matlab.pdf (2012)
5. Malik, D.S.,. C++ Programming : from Problem Analysis to Program Design. Florence, USA, Cengage Learning (Latest Edition)

EMH 102/3 – Fluids Mechanics

Objective: To introduce the concept of a fluid and hence to provide knowledge on the fundamentals of static and dynamic flows.

Synopsis: The course is an introductory course to cover basic principles and equations of fluid mechanics with the concept of static and dynamics conditions of fluid. This will present numerous and diverse real-world engineering applications for student to apprehend on how fluid mechanics is applied in engineering practice, and also to develop an intuitive understanding of fluid mechanics by emphasizing the physics of the fluid mechanics.

Course Outcome:

1. Able to have a working knowledge of the basic properties of fluids and comprehend the continuum approximation. Also able to calculate the capillary rise (or drop) in tubes due to the surface tension effect.
2. Able to determine the variation of pressure in a fluid at rest. Able to calculate the pressure using various kind of manometers and also able to analyze the stability of floating and submerged bodies.
3. Able to apprehend the role of the material derivative in transforming between Langragian and Eulerian descriptions.
4. Ability to calculate the flow field for inviscid fluid flow, applying the Bernoulli equation and continuity equation for flow measurements and to know the new technique or instruments for flow measurement in engineering practice.
5. Able to comprehend the laminar and turbulent flow in pipes and the analysis of fully developed flow. Able to calculate the major and minor losses associated with pipe flow in piping networks and determine the pumping power requirements. Able to apprehend the application of various velocity and flow rate measurement techniques and learn their advantage and disadvantages.
6. Able to develop better understanding of dimensions, units and dimensional homogeneity of equations and numerous benefits of dimensional analysis. Able to use the method of repeating variables to identify nondimensionless parameters. Able to understand the concept of dynamics similarity and able to apply for prototyping analysis.

References:

1. Y. Cengal and J.M. Cimbala, Fluid Mechanics, McGraw Hill, 2006.
2. M.C. Potter and C. David, Mechanics of Fluids, Brooks/Cole, 2001.
3. Bruce, R. Manson, Donald, F. Young, Theodore H. Okishi, Fundamentals of Fluid Mechanics, John Wiley and Sons, 1990.

EMM 102/3 – Statics

Objective: To provide the students with the basic knowledge in the mechanics of rigid body, especially in the concept of statics and strength of materials. Considerations are given in order the students to effectively implement the basic of mechanics such a free-body diagram and force vector to analyse the static force system in 2D and 3D equilibriums.

Synopsis: This course is an introductory to engineering mechanics where the students will learn the concept and notation of forces and moments, free body diagram, equilibrium of a particle, force system resultant, equilibrium of rigid body, structural analysis, centre of gravity, centroid, second moment of area, stress and strain, axial loading and mechanical properties of materials.

Course Outcome:

1. Able to express and resolve the position and force into vector unit components.
2. Able to define the system of forces and moments and calculate the resultants of force using the concept of equilibrium system.
3. Able to draw and describe the free-body diagram and to solve the problems using the equations of equilibrium.
4. Able to determine the forces in the members of trusses and frames using the method of joints and sections.
5. Able to determine to the location of centre of gravity and centroid for a system and to determine the moment of inertia for an area.
6. Able to define normal, shear, bearing and thermal stresses and deformation of axially loaded members, and able to express the stress-strain diagram.

References: 1. Russell Charles Hibbeler, Statics and Mechanics of Materials, SI ed., Pearson Prentice Hall, 2009.

EMD 112/2 – Conceptual Design and CAD

Objective: To introduce and hence, to provide knowledge of the basic concepts of design and introduction to the computer aided design (CAD) as well as CATIA software. Considerations are given on the production of 3-dimensional design from engineering drawings as well as to enhance the communication skills, team participation and writing technique of technical report.

Synopsis: This course introduces basic concept in design process, techniques and tools used. It exposes the student to design new products or/and improve the existing products through conceptual design. This course will expand the application of computer aided design (CAD) software such as CATIA in the design processes starts with sketching the design idea towards producing a final model. This will provide the student with a better

understanding of CAD software applications, able to create 3 dimensional products, assemble the models and also be able to produce mechanical drawing of high enough quality to be used in a design portfolio.

Course Outcome:

1. Able to identify design problems.
2. Able to develop concepts for solving the design problems.
3. Able to apply CAD software to do sketching, part and surface modelling, create assembly models, and produce mechanical drawing in computer.
4. Able to produce a design portfolio based on selected design project.

References:
1. Rudolph J. Eggert: Engineering Design, Prentice Hall.
2. Ullman, D.G., The Mechanical Design Process, 3rd Ed., McGraw-Hill, New York, 2003.
3. CATIA V5 workbook.

EUM 114/3 – Advanced Engineering Calculus
(Offered by the School of Electrical Engineering)

Objective: This course covers the concepts of linear algebra, Fourier series, partial differential equation and vector calculus. This course will provide students with a variety of engineering examples and applications based on the above topics.

Synopsis:

Linear algebra
Determinants, inverse matrix, Cramer's rule, Gauss elimination, LU (Doolittle and Crout), eigen value and vector eigen, system of linear equation, numerical method for solving linear equation: Gause Seidel and Jacobian.

Fourier series
Dirichlet condition, Fourier series expansion, function defined over a finite interval, half- range cosine and sine series.

Vector Calculus
Introduction to vectors, vector differentiation, vector integration: line, surface and volume, Green's, Stoke's and Gauss Div theorems.

Partial differential equation
Method for solving the first and second order PDE, linear and non linear PDE, wave, heat and Laplace equations.

Course Outcome:

1. Defining the concept of linear algebra, fourier series, partial differential equations and vector calculus.
2. Recognize and use mathematical operations involved in the learned concepts above.
3. Using numerical methods to obtain solutions of the system of linear equations and partial differential equations
4. Apply the concept of learning outcomes above for solving problems related to engineering.

References:

1. Glyn J., (2010).Modern Engineering Mathematics, 4th Edition Pearson
2. Glyn, J., (2010). Advanced Modern Engineering Mathematics, 4th Edition. Pearson
3. Ramana, B.V (2007) Higher Engineering Mathematics, 1st Edition. Tata Mc Graw Hill
4. Peter V.O'Neil (2007). Advanced Modern Engineering Mathematics, 1st Edition. Thomson
5. Ron Larson, Bruce H. Edwards (2009). Calculus, 9th Edition. Brook ColeSteven.
6. Chapra, Raymond Canale (2009). Numerical Method for Engineers, 6th Edition. Mc Graw Hill
7. D.Vaughan Griffith, I.M Smith (2006). Numerical Method for Engineers, 2nd Edition. Chapman and Hall.
8. Kreiyzig, E., (2010). Advanced Engineering Mathematics, 10th Edition.Wiley.
9. J.N.Sharma. (2007). Numerical Method for Engineers, 2nd Edition. Alpha.
10. Smith R. T. and Minton, R., (2008), Calculus, 3rd Edition, Mc Graw Hill.

EMC 201/3 – Measurement and Instrumentation

Objective: To provide knowledge on the basic principles of measurement and instrumentation systems, including various methods of sensing and their applications, instrument types and characteristics, measurement process and standards, and measurement of various physical parameters.

Synopsis: This course is designed to emphasize the importance of mechanical measurements early on in the programme so that the learners will understand the various sensing methods and their applications. The course starts with on overview of the measurement process and standards, followed by signal conditioning and data processing. The second half of the course deals with the measurement of various physical quantities such as pressure, fluid flow, strain, temperature etc.

Course Outcome:

1. Able to explain the process of measurement and identify the various stages and elements in a typical measurement system.
2. Able to determine the uncertainty in a set of measurement data for a given confidence level.
3. Able to construct the frequency spectrum for a complex waveform.
4. Able to analyze first order and second order measurement systems subjected to step and sinusoidal inputs.
5. Able to identify and explain the various sensing methods and their applications.
6. Able to apply signal conditioning fundamentals to process signals from measurement systems.
7. Able to apply digital methods in mechanical measurement.
8. Able to apply knowledge in measurement system in strain, temperature, pressure and flow measurement.

References:

1. T.G. Beckwith, R.D. Maragoni, J.H. Lienhard, Mechanical Measurement, 6th ed., Prentice Hall, 2006.
2. J.P. Bently, Principles of Measurement System, 3rd ed., Longman, 1995.
3. R.S. Figliola, D.E. Beasley, Theory and Design for Mechanical Measurements, 3rd ed., John Wiley, 2000.
4. A.S. Morris, Measurement and Instrumentation Principles, 1st ed., Butterworth Heinemann, 2001.

EPP 201/3 – Manufacturing Technology I

Objective: To introduce to the students with the fundamental concepts and implementation of basic manufacturing processes.

Synopsis: This course is an introduction to manufacturing technology and processes covering fundamental processes such as metal casting, bulk deformation processes material removal process, fusion and mechanical joining.

Course Outcome:

1. Able to describe the crystal structure, the mechanical and physical properties of metals.
2. Able to differentiate ferrous and non-ferrous alloys, their properties and processing.
3. Able to distinguish the various kind of fundamental casting processes and the defects from casting.
4. Able to formulate and calculate basic mechanisms of bulk deformation processes such as forging, extrusion, rolling and drawing.
5. Able to formulate and calculate various techniques of sheet metal working processes such as cutting, bending and drawing.
6. Able to analyse metal removal processes such as machining and evaluate tool life.
7. Able to explain mechanical joining and fusion.

References:
1. S. Kalpakjian, Manufacturing Engineering and Technology, 5th Ed., 2006, Pearson -Prentice Hall. ISBN 0-13-197639-7.
2. Groover, Fundamentals of Modern Manufacturing, 4th Edition, John Wiley. ISBN 0-471-40051-3

EML 211/2 – Engineering Laboratory I

Objective: To provide better understanding on the theoretical classes through the relevant experiments.

Synopsis: This is a practical subject designed to let the students apply fundamental understanding in the areas of mechanical engineering such as solid mechanics, materials properties, fluid mechanics and electrical circuits. The students will learn on a 'hands-on' basis the actual application and observe the differences between theoretical and practical knowledge in mechanical engineering. They are expected to find references that will enable further understanding of the topic as well as explanation of the differences between theoretical and experimental results. An objective test is conducted at the end of the course to ensure that the students grasp the major lessons learned in the labs.

Course Outcome:

1. Able to apply some major principles of solid mechanics in lab works and able to relate them for practical applications in lab report.
2. Able to apply some major principles of fluid mechanics in lab works and able to relate them for practical applications in lab report.
3. Able to apply some major principles of thermodynamics in lab works and able to relate them for practical applications in lab report.
4. Able to apply some major principles of electrical circuits in lab works and able to relate them for practical applications in lab report.
5. Able to recall and comprehend the major lessons learned from report writing talk and lab sessions.

References:
1. Lab Book consisting of instructions and all experiment information is provided.
2. Various textbooks related to the respective taught courses.

EMH 211/3 – Thermodynamics

Objective: To introduce the fundamental concepts of energy, work and heat, as well as to provide understanding on the thermodynamic concepts, first and second thermodynamic laws.

Synopsis: The course introduces the energy resources in the word including renewable and fossil based fuels. Properties of thermodynamic fluids and basic concepts are introduced. Thermodynamics phase diagrams of pure substance are introduced followed for opened and closed system. The second law and entropy are introduced followed by thermodynamic cycles. Practical cycle such as steam or Rankine cycle, Brayton, Otto, Diesel and the vapour compression cycle are introduced.

Course Outcome:

1. Able to define and explain the basic concepts including the First Law of Thermodynamic and to derive the corollaries of the First Law.
2. Able to solve problems for each thermodynamic process using steam or air.
3. Able to explain the Second Law of Thermodynamics and its corollaries, entropy and explain thermodynamic processes based on T-s diagram.
4. Able to determine the performance of various steam and air thermodynamics cycle

References:
1. T.D. Eastop and A. McConkey, Applied Thermodynamics for Engineers and Technologist, Longman, 2006.
2. Y. Cengel and C. David, Thermodynamics, McGraw Hill, 2004.

EMT 211/3 – Engineering Probability and Statistics

Objective: A fundamental course to identify and to solve engineering problems using the probability and statistics concepts.

Synopsis: This course covers topics in the roles of statistics in engineering, fundamentals of probability and their applications, sampling distributions, data analysis, regression and correlations, and design of experiment. The students are exposed with basic approaches in the solutions of engineering problems related to data analysis and sampling distributions.

Course Outcome:

1. Able to identify the factors in probability and statistics and to relate this knowledge in engineering applications.
2. Able to differentiate between dependent and independent conditions and to identify the appropriate probability theorems applications including the conditional probability.
3. Able to construct hypotheses tests, to evaluate expectation and to apply various sampling techniques in statistical tests.
4. Able to apply regression and correlation principles in engineering problems

5. Able to identify relations among parameters and to use the concepts of regression and correlation to develop relation among parameters.
6. Able to analyze patterns and procedures in design of experiments including to determine problems, to identify dependent and independent parameters and to analyse data.

Reference:
1. S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 4th ed., Elsevier Academic Press, 2009.
2. J.L. Devore, Probability and Statistics for Engineering and the Sciences, 7th ed., Duxbury, 2008.

EMM 213/3 –Strength of Materials

Objective: To enhance student knowledge on the basic principles of solid mechanics and design problem solution.

Synopsis: This course is an introduction to the strength of materials where the student will be provided with both the theory and application of the fundamental principles to determine the internal stresses, deflections and torsion of basic load carrying members.

Course Outcome:

1. Able to determine stress and deformation of simple deformable structural under torsional loadings.
2. Able to determine the stress in beams and shafts caused by bending.
3. Able to analyze the shear stress in a beam.
4. Able to determine the deflection and slope on beams and shafts.
5. Able to analyze the stress developed in thin-walled pressure vessels as well as to establish stress analysis of the structure with regards to combined loadings of axial, torsional, bending and shear loads.
6. Able to apply the strain transformation methods using generalized equations, and Mohr's Circle, and measuring the strain and developing the material-property relationship using Hooke's Law.

References:
1. F.H. Cheng, Statics and Strength of Materials, 2nd ed., McGraw Hill, 1998.
2. R.C. Hibbeler, Mechanics of Material, 3rd ed., Prentice Hall, 1997.
3. P.P. Benham & R.J. Crawford, Mechanics of Engineering Materials, ELBS, Longman, 1989.

EMT 212/3 – Computational Engineering

Objective: To bridge students' theoretical and analytical skills gained from basic calculus, linear algebra, differential equations and discrete techniques into physical and engineering exposures.

Synopsis: This course covers selected topics in computational mathematics that deal with steady-state equations, evolutionary equations, optimization, dynamics and equilibrium of structures, etc. Applications of the introduced methods for solving physics and engineering problems are emphasized.

Course Outcome:

1. Able to identify and relate various concepts and equations in mathematics to real-world problems in engineering.
2. Able to formulate and solve analytically and numerically based on differential equations for field problems and its derivative.
3. Able to apply theorems in Calculus to solve for optimization problems.
4. Able to formulate solutions in engineering problems based on vector calculus and differential equations.

References:

1. G. Hagen, L. Thomas, and D. Passeri (2010). UCF EXCEL Applications of Calculus II. University of Central Florida.
2. J. D. Logan (2006). A First in Course in Differential Equations. Springer (e-book)
3. S. Chapra and R. Canale (2006). Numerical Methods for Engineers, McGraw-Hill.
4. K.F. Riley, M.P. Hobson, and S.J. Bence (2006). Mathematical methods for physics and engineering. Cambridge University Press.
5. Hildebrand (1976) Advanced Calculus for Applications. 2nd ed. Englewood Cliffs: Prentice Hall.

EPM 212/3 – Metrology and Quality Control

Objective: To provide comprehensive knowledge of the science of dimensional measurements such as measurement errors, principle of precision measurement tools, surface measurement and to enable students to design and practice the quality control system.

Synopsis: This course combines two complementary areas in manufacturing: Metrology and Quality Control. Metrology, as the front end of quality control, emphasizes on fundamental concepts of dimensional measurement, various measurement instrument (hardware) implementations and data acquisitions. Quality control, on the other hand, focuses on the interpretation and analysis of measurement data based on statistical concepts. Topics included in quality control are introduction to quality concept and its relationship to cost and productivity; quality tools

that are used in improvement processes like quality tools, statistical process control; quality design and studies on process capability and improvement.

Course Outcome:

1. Able to explain and compare the various measurement terminologies
2. Able to identify the various types of measurement errors and perform calculations to determine these errors.
3. Able to: (i) explain the working principle of precision instruments such as vernier and micrometre instruments, comparators etc., (ii) determine flatness error and parallelism between surfaces using optical flats, (iii) determine surface roughness and roundness of machined parts, and (iv) identify various types of coordinate measuring machines and identify their relative advantages and applications.
4. Develop global mindset where metrology measurements are viewed in perspective of quality control.
5. Able to analyse statistically the data collected to observe process maintainability ability by using a sampling plan and control charts
6. Able to analyse statistically the data collected to observe process conformance to engineering specifications using statistical means

References:

1. C.L. Dotson, Fundamentals of Dimensional Metrology, Thomas Delmar Learning, 2007.
2. G.W. Gaylor, Shotbolt, Metrology for Engineers, Shotbolt, 1999.
3. D.C. Summers, Quality, 4th ed., Pearson Prentice Hall, 2006.
4. D.H. Besterfield, Quality Control, 7th ed., Pearson Prentice Hall, 2004.

EMH 222/3 – Fluids Dynamics

Objective: To introduce the application of potential flows in turbo machine, hydraulic turbines and analysis of fluids power system and their applications.

Synopsis: This course is an Introduction to the ideal & viscous fluid flow theories, different forms of fundamental laws in fluid dynamics, boundary layer, concept of compressible flow, adiabatic and isentropic flow with area changes, normal shock wave, converging & diverging flow and turbomachines.

Course Outcome:

1. Able to derive and apply the differential equations of different fluid motion amely the continuity and Newton's 2nd Law to every point in the flow field.
2. Able to do approximations that eliminate the terms reducing the Navier-Stokes equation to a simplified form and to approximate the flow in the region of flow away from the walls and wakes.
3. Able to explore and determine the drag force, friction drag and flow separation. Also, able to examine the development of the velocity boundary layer during

parallel flow over a flat plate surface, relations for the skin friction and drag coefficient for flow over flat plates and cylinders and spheres.

4. Able to review the concepts of stagnation state, speed of sound and Mach no for compressible flows. Able to calculate the fluid properties for 1D isentropic subsonic and supersonic flows through converging and converging-diverging nozzles, across normal and oblique shock waves and the effect of friction and heat transfer on compressible flows.
5. Able to classify turbomachines into two broad categories i.e. pumps and turbines and qualitatively explaining the basic principle of their operation. Able to analyse the overall performance of turbomachines by matching the requirements of a fluid flo system to the performance characteristics.

References:

1. R.P. Benedict, Fundamentals of Gas Dynamics, London: John Wiley, 1983.
2. Bruce, R. Manson, Donald, F. Young, Theodore H. Okishi, Fundamentals of Fluid Mechanics, John Wiley and Sons, 1990.
3. J.F. Douglas, J.M. Gasiorek & J.A. Swaffield, Fluid Mechanics, 2nd ed., London, Pitman, 1985.

EMM 242/2 – Dynamics

Objectives: To expose students to the concepts and principles of engineering applications, especially dynamics in mechanical engineering.

Synopsis: This course will provide the students with concepts and principles of engineering in analyzing dynamics of rigid-body. The students are then introduced to the applications of dynamics in solving a bar mechanisms problem.

Course Outcome:

1. Able to describe the kinematic rigid-body movement and use the equations of motion to solve dynamic problems.
2. Able to use the principles of work and kinetic energy in solving problems.
3. Able to use the principle of impulse and momentum to solve kinetic problems.
4. Able to graphically and analytically determine the position, displacement, velocity and acceleration of a bar mechanism.

References:

1. Meriam & Kraige "Engineering Mechanics: Dynamics", 7th Edition, Vol II, John Wiley and Sons, 2012.
2. R.C. Hibbler, Engineering Mechanics: DYNAMICS, 11th Edition, Prentice Hall, 2007.

EMD 223/2– Machine Component Design

Objective: To design, analysis and selection of commonly used mechanical components subject to static and dynamic loads.

Synopsis: In this course the student will be required to apply the knowledge gained in the previous three semesters, particularly in Design I, Statics, Strength of Materials and Mechatronics, to design machine components such as shafts, keys, bearings, gears, belt & pulley, fasteners and welded joints.

Course Outcome:

1. Able to define and calculate various loads/stresses as applied to fasteners, and compute design values.
2. Able to calculate various loads as applied to shaft, and specify appropriate design stresses for shaft.
3. Able to specify suitable keys and couplings for shaft and other type of machine elements.
4. Able to analyse and design welded joint to carry many type of loading patterns.
5. Able to analyse and design spur gear, helical gear and bevel gear.
6. Able to analyse and design of rolling element bearings.
7. Able to analyse and design of lubrication and sliding bearings.
8. Able to design, develop and produce solution to meet the needs of specific tasks in the design project.

References:

1. J.E. Shigley, C.R. Mischke and R.G. Budynas, Mechanical Engineering Design, 7th ed., McGraw Hill, 2003.
2. J.A. Collins, Mechanical Design of Machine Elements and Machines, Intl ed., Wiley, 2003.
3. B.J. Hamrock, S.R. Schmid and B. Jacobson, Fundamentals of Machine Elements, 2nd ed., McGraw Hill, 2005.

EMC 311/3 – Mechatronic

Objective: To integrate the technology areas including sensor and measurement system, drive and movement systems, analysis system of behaviour, control systems and micro processing system.

Synopsis: The basic principles underlying mechatronic systems involving the integration of mechanical and electrical components with some form of electronic control (computer, microcontroller, PLC, discrete electronics or other) forming an intelligent and flexible machine, are explained. The programmable logic controller (PLC) and microcontroller, are studied in depth. Sensors will be explained as input to the controllers, and various actuators will be explained as the output effectors. Various types of actuation system including electrical, pneumatic and hydraulic drives that can be activated in different ways by programming ladder diagram in the

PLC and BASIC language programming for the microcontroller are explained as well.

Course Outcome:

1. Able to describe a typical mechatronic system.
2. Able to formulate logic function digitally.
3. Able to operate PLC and program ladder diagram.
4. Able to operate raspberry pi and program python.
5. Able to design pneumatic and hydraulic circuits using various acuation and control elements.
6. Able to identify the basic element used in an electrical actuation system and explain their underlying principles of operation.
7. Able to integrate the various sensor and actuation systems using PLC in developing a typical mechatronic system.

References:

1. A.K. Stiffler, Design with Microprocessors for Mechanical Engineers, McGraw-Hill, 1992.
2. D.M. Auslander, C.J. Kempf and B. Stenquist, Mechatronics: Mechanical System Interfacing, Siwon & Schuster, 1995.
3. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Addison Wesley Longman, 1999.

EML 331/2 – Engineering Laboratory II

Objectives: To provide the understanding on the theoretical classes through the experiments.

Synopsis: This is a practical subject designed to let the students try to apply fundamental understanding in the areas of mechanical engineering such as thermodynamics, applied mechanics and manufacturing tolerances. The students will learn on a 'hands-on' basis of the actual application and observe the differences between theoretical and practical knowledge in mechanical engineering. They are expected to search for references that will enable further understanding of the topic as well as explanation of the differences between theoretical and experimental results.

Course Outcome:

1. Able to apply some major principles of solid mechanics in lab works and able to relate them for practical applications in lab report.
2. Able to apply some major principles of fluid mechanics in lab works and able to relate them for practical applications in lab report.
3. Able to apply some major principles of thermodynamics in lab works and able to relate them for practical applications in lab report.
4. Able to explain basic principles of properties of material and relate them for practical applications.

5. Able to recall and comprehend the major lessons learned from report writing talk and lab sessions.

Reference:
1. Lab Book consisting of instructions and all experiment information is provided.
2. Various textbooks related to the respective taught courses.

EMM 331/3 – Solid Mechanics

Objective: To introduce the advance topics in solid mechanics and application for engineering systems in practice.

Synopsis: Calculations of stress concentration, creep, energy theorem, plate and shells. Torsion for non-circular section and thin walls. Unsymmetrical bending, beam and fatigue. Failure criterion and introduction to fracture mechanics.

Course Outcome:

1. Able to describe the creep phenomena and to use the right formula to investigate this phenomena.
2. Able to calculate the displacement by energy methods.
3. Able to recognize the existence of stress concentration in engineering components and be able to calculate the stress concentration factor.
4. Able to apply theories of failure in determining the failure of a material.
5. Able to competently apply the concepts of fracture mechanics in investigating the crack phenomena.
6. Able to apply the concept of fatigue to solve for the time taken for fatigue in metal and other fatigue-related problems.

References:
1. P.P. Benham & R.J. Crawford, Mechanics of Engineering Materials, ELBS, Longman, 1989.
2. A.P. Boresi, R.J. Schmidt and Sidebottom, O.M. Advanced Mechanics of Materials, 5th ed., New York, John Wiley and Sons, Inc., 1993.

EPP 331/4 – Manufacturing Technology II

Objective: To introduce principles and practices in engineering production process using various manufacturing techniques.

Synopsis: Further studies on metal working processes, metal casting and joining processes, material removal and machine tool technologies, non-traditional machining (NTM) methods, powder metallurgy, non-metal and polymer processing, process selection for economic manufacturing, basic concepts of automated manufacturing systems technology.

Course Outcome:

1. Recognise the various non-metallic material processing technique and the characteristic of each processes.
2. Appreciate the powder metallurgy processing in producing net shape parts from metal powder.
3. Understand the basic concept of machine tools technology and provide background on the importance of machining and reducing machining cost.
4. Able to distinguish the working principles, process characteristics, process parameters and area of applications in non- traditional machining and the importance of prototyping.
5. Competent in the procedure of design for manufacturing, selecting a suitable material and process for production.
6. Comprehend the concept of integrated manufacturing system towards achieving higher productivity and reducing cost.

References:
1. S. Kalpakjan, Manufacturing Engineering and Technology, 3rd ed., Addison Wesley, 1995.
2. M.P. Groover, Fundamentals of Modern Manufacturing, Prentice-Hall, 1996.
3. J.A. Schey, Introduction to Manufacturing Processes, 2nd ed., McGraw-Hill Inc., 1987.

EMH 332/3 – Applied Thermodynamics

Objective: To introduce the application of psychometric chart in air-conditioning and analysis of combustion applications in internal combustion engine.

Synopsis: This course is to enhance the students' fundamental understanding of the application of thermodynamics systems covering the areas of psychrometry and air conditioning, mixtures, combustion, internal combustion engines (ICE) and reciprocating compressors.

Course Outcome:

1. Able to analyse the principles of mixtures of gases and vapours with capability to apply them for practical applications.
2. Able to analyse the principles of combustion chemistry and processes with capability to apply them for practical applications.
3. Able to analyse the principles of psychometric and air-conditioning with capability to apply them for practical applications.
4. Able to distinguish the difference between the working principle of two-stroke and four-stroke engine, ideal and actual engine cycles, determine various engine performance parameters, and provide brief explanation of combustion in spark ignition and compression ignition engine.
5. Able to draw the p-V diagram for a single and multistage compression, determine and calculate the performance parameters of a reciprocating air compressor.

References:
1. T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineers and Technologist, Longman, 2006.
2. Y. Cengel and C. David, Thermodynamics, McGraw Hill, 2004.

EMT 302/3 – Mathematical Modelling in Engineering

Objective: An application-oriented mathematics course to train students with the capability to transform real world phenomenon into mathematical models whose analysis provides the insights for engineering based problem solving

Synopsis: This course focuses on problem solving aspects using mathematical modeling skills in engineering. Introduction to problem identification, appropriate mathematical model generation, data collection, validation and verification of a model will be exposed for solving physics and engineering problems.

Course Outcome:

1. Able to translate relatively complex real systems to mathematical expressions.
2. Able to generate or select appropriate models with different solutions strategies.
3. Able to analyze models and suggest correct solution process.
4. Able to demonstrate modeling capability using Maple in selected test cases.

Reference:
1. S. Heinz (2011), Mathematical Modeling, Springer.
2. I. Tosun (2007), Modeling in Transport Phenomena, Elsevier.
3. T Svobodny (1998) Mathematical Modeling for Industry and Engineering, Prentice Hall

EMC 322/3 – Automatic Control

Objective: To introduce the concepts related to the theories of control system in time domain and to explain various basic techniques of designing control system.

Synopsis: This course introduces the theory of control system in time domain. It shows how to model a physical system into mathematical equations and program simulation for the system response. It then describes the feedback control system characteristics. After that it explains how to measure the performance and determine the stability of the feedback control systems. Finally, it describes the root locus method and how to use it for designing a feedback control system.

Course Outcome:

1. Able to describe the linear control system theory in time domain.
2. Able to model a physical system into mathematic equations and block diagram, and program a system response simulation.
3. Able to analyze the feedback control system characteristics.

4. Able to measure the performance and determine the stability of the feedback control system.
5. Able to draw the root locus and use it to design a feedback control system.

References:
1. R.C. Dorf and R.H. Bishop, Modern Control Systems, Addison Wesley, 8th ed., 1998.
2. Mahmud, Che Mat Hadzer, Sistem Kawalan Automatik, USM, 1999.
3. K. Ogata, Modern Control Engineering, 3rd ed., Prentice Hall, 1997.

EMD 332/2 - Machine Design

Objective: Integration of all (or most of) the machine elements studies in EMD 332/2 to design a mechanical system that is expected to perform a certain task using the principles of fluid mechanics, thermodynamics and strength of materials.

Synopsis: This design course covers the aspect of machine design. It emphasises on the process of design which includes market research and patent search to ensure viability and the designed products did not breach existing patent. The application of function decomposition technique to achieve the desired function in the end design. The design is expected to be presented using solid model and later fabricated in the workshop and tested for its performance to validate the design claims.

Course Outcome:

1. Able to analyze a given mechanical design problem using standard engineering principals, taking the initial specifications to a conceptual design.
2. Able to develop a detailed design and proposing a well defined solution including manufacturing, assembly and testing details.
3. Able to appropriately apply tools such as the decision matrix, and FMEA as well as the typical mechanical analysis (ie. strain, power) and other aspects such as cost, and environmental concerns.
4. Able to communicate details of mechanical designs both written and orally, by write reports, give presentations, answer questions en vivo and design an informational poster

References:
1. J.E. Shigley, C.R. Mischke and R.G. Budynas, Mechanical Engineering Design, 7th ed., McGraw Hill, 2003.
2. J.A. Collins, Mechanical Design of Machine Elements and Machines, Intl ed., Wiley, 2003.
3. B.J. Hamrock, S.R. Schmid and B. Jacobson, Fundamentals of Machine Elements, 2nd ed., McGraw Hill, 2005.

EPM 322/3 – Industrial Engineering

Objective: To give an exposure to students with several industrial engineering techniques and job-review application, ergonomics, financial compensation, motivation and project management.

Synopsis: Industrial engineering application main objective is the effective use of method, capital, time, human resource, space and equipment to achieve high productivity and quality. This introductory course emphasize the techniques and procedures for the planning and designing the effective use of these integrated resources in the manufacturing environment Prerequisite : Minimum Third year standing

Course Outcome:

1. Relate productivity to industrial engineering techniques in work improvement.
2. Perform study, analysis & make improvement on work method and on shop-floor operation.
3. Perform measurement on work and synthesize standard operation time. Able to design factory and equipment layout.
4. Perform study & analysis on some relevant industrial psychology.

References:
1. R.M. Barnes, Motion and Time Study, N.Y.: Wiley, 1980.
2. D.R. Herzog, Industrial Engineering Methods and Controls, Reston, Virginia: Prentice Hall, 1985.
3. Hicks, Industrial Engineering & Management, McGraw Hill, 1994.

EML 342/2 – Engineering Laboratory III

Objective: Experiments related to the theories covered during the lectures.

Synopsis: This is a practical subject designed to let the students try to apply fundamental understanding in the areas of mechanical engineering such as applied thermodynamics, manufacturing processes, control and finite element analysis (FEA). The students will learn on a 'hands-on' basis of the actual application and observe the differences between theoretical and practical knowledge in mechanical engineering. They are expected to search for references that will enable further understanding of the topic as well as explanation of the differences between theoretical and experimental result.

Course Outcome:

1. Able to apply some principles in manufacturing processes and relate them for practical applications.
2. Able to apply some major principles of thermodynamics, performance of internal combustion engines and understand basic mode of heat transfer mechanisms.
3. Able to explain basic principles of a position servo system for practical applications.

4. Able to run the ANSYS software for Finite Element Analysis (FEA) applications.

Reference:
1. Lab Book consisting of instructions and all experiment information is provided.
2. Various textbooks related to the respective taught courses.

EMM 342/3 – Noise and Vibrations

Objective: To provide students with the theories of noise and vibration. Also, to give an exposure to students of various instrumentation for measuring the noise and vibration.

Synopsis: This course is an introductory course to vibration and noise where the students will be given fundamentals of vibration for a single degrees of freedom system and important concepts of noise. This will provide the student with basic ability to determine the response of the system for a harmonic forcing function and also to select suitable vibration attenuation methods by increasing damping or adjusting system dynamics. The students are then introduced to a two-degrees-of- freedom system to form the basis of future studies on multi-degrees of freedom system. The concept of mode shapes are introduced here and these are then applied to a tuned vibration absorber system as an application of the theories given. For the important concepts in Noise, the students are introduced to fundamental properties of sound waves, the production, transmission and measurement of sound. Then these concepts will be applied in noise control of enclosed system.

Course Outcome:

1. Able to determine vibration response for a 1 degree-of-freedom system [displacement, velocity, acceleration].
2. Able to calculate natural frequencies and mode shapes for a 2 degrees of freedom system.
3. Able to design tuned vibration absorber system.
4. Able to describe important concept of sound including the generation, transmission and effects of sound waves.
5. Able to calculate the basic parameters of sound.
6. Able to measure and design room acoustics.

References:

1. Abdul-Rahman, R, Lecture Notes on Vibration, Latest Edition.
2. Steidel, R. F. Jr, An Introduction to Mechanical Vibrations, John Wiley & Sons. (Latest Edition)
3. Hibbeler, R.C. Engineering Mechanics: Dynamics, Prentice Hall, (Latest Edition; Chapter 22)
4. Meriam, J. L. and Kraige L .G. Engineering Mechanics: Dynamics, John Wiley & Sons.(Latest Edition; Chapter 8)

5. Rao, S. S., Mechanical Vibrations, Pearson/ Prentice Hall, Latest Edition.
6. Said, A. K. 'Pengenalan Akustik', 1990, UTM.

EMH 441/3 – Heat Transfer

Objective: To equip the students with understanding and imagination of knowledge in fundamental heat transfer i.e. conduction, convection, radiation and design.

Synopsis: From the study of thermodynamics, the energy can be transformed by the interactions of a system with its surroundings. These interaction are known as work and heat. However, thermodynamics deals with the end states of the process during the interaction occurred and provides no information concerning the nature or the time rate these interaction occurred. The heat transfer course will extend the thermodynamics analysis through study of the modes of heat transfer and through the development of relations to analyse the heat transfer rates.

Course Outcome:

1. Able to develop an appreciation for the fundamental concepts and principles on the heat transfer processes.
2. Able to develop a further understanding using the Fourier's Law to determine expressions for the temperature distribution and heat transfer rate for common geometries.
3. Able to develop the means to perform convection transfer calculations to further quantify convection coefficient in forced convection and natural convection.
4. Able to understand and to determine the performance parameters for assessing the efficiency of a heat exchanger.
5. Able to develop methodologies for designing a heat exchanger or predicting performance under prescribed operating conditions.
6. Able to give particular attention on how the thermal radiation is generated, the specific nature of the radiation and the manner in which it interacts with matter.

Reference:
1. J.P. Holman, Heat Transfer, 7th ed., Mc Graw Hill, 2001.
2. InCropera, F.P., Dewit, D.P., Fundamental of Heat and Mass Transfer, 3rd ed., John Wiley, 1990.
3. S.P. Sukhatme, A Test Book of Heat Transfer, Orient Longman, 1989.

EMD 431/4 – Mechanical Engineering Integrated Design

Objective: To expose the students to the capstone design in mechanical engineering course of study for which the entire science is used to solve complex design problems with open-ended solutions. This course focuses on team-oriented projects involving complex mechanical systems. Through theoretical knowledge to work on the overall level of education, the project requires the application of realistic constraints in engineering such as manufacturability and economics as well as issues related to safety and ethics.

Synopsis: The integrated design course is the capstone of all the design courses offered in the mechanical engineering course at USM through a group mode in which a group of student will work in a team to produce a design based on a real engineering applications. This course will offer students design projects of an open-ended nature proposed by the industry or the project sponsors, that requires a multidisciplinary approach to the solution. Students will apply engineering process design, define functional requirement, conceptual method, analyse and identify actions to overcome risk within the scope of the project. Student will be required to produce a design and verify the performance of the design based on standard engineering code and guidelines. Student will have to interact in a group to develop leadership skill and demonstrate group dynamics to respon to schedule conflict, weekly meetings and fulfill deadlines; through communications within the group, project sponsors and group supervisor. Students will be required to attend related lectures given by representative from the industry and academics. At the end of the semester, students are required to give presentations and demonstrate their design to a group of examiners, invited guests from the industry and other students in the design course.

Course Outcome:

1. Able to obtain information related to sub-topics of mechanical engineering for the project implementation.
2. Able to procure relevant and reliable references from the mechanical engineering handbooks and guides that take into account the sustainability of the project.
3. Able to deal with reliability of the component design, system installation and mechanical engineering.
4. Able to create measurement / verification of certain parameters relating to certain mechanical system design capabilities.
5. Able to interact with group members either as chairman or member in the project planning and execution.
6. Able to make an assessment regarding financial factors related to the project design of mechanical systems.
7. Able to prepare and present the integrated design report.

References:
1. A.D Biran “What Every Engineer Should Know about Matlab and Simulink” CRC Press, 2010.

2. R.G. Budynas and J.K. Nisbett "Shigley's Mechanical Engineering Design" 10th Ed. McGraw-Hill Education, 2015.
3. E. Avallone,T. Baumeister, A. Sadegh "Marks' Standard Handbook for Mechanical Engineers" McGraw-Hill Professional (2006).
4. William J Palm III "Modeling, Analysis and control of Dynamic Systems" 2nd Ed, John Wiley and Sons (1999).

EPC 431/3 – Robotic and Automation

Objective: To introduce to students the industrial robot, automation system and their applications in manufacturing industrial automation.

Synopsis: This course explains the knowledge and technology required to apply robotics for automating manufacturing industry. The contents include automation, robot definition, robot structure, robot application, robot programming, kinematics analysis, end effectors, sensors, actuator and robot controller. The learning is centered on the industrial robotic arm cell and wheel mobile robots that are available in the School of Mechanical Engineering, Universiti Sains Malaysia. Throughout the course, the students are required to program the robot from a simple sequential program growing to a complicated program that can complete a task for manufacturing process. While the student programming the robot, the knowledge and technologies that are required in robotic will be thought gradually.

Course Outcome:

1. Able to describe the definition and application of robotic and recognize the structures and components of various robots including industrial robot arms and mobile robots.
2. Able to choose and configure the actuators for driving a wheel mobile robot as well as to control and program electrical motors.
3. Able to operate and program an industrial robot arm as well as utilize the right end effectors and integrate sensors.
4. Able to model the kinematic relationship and calculate the joint angles of an industrial robot arm and a mobile robot from a given position and orientation.
5. Able to automate a manufacturing process by integrating an industrial robot arm with production machines.

References:
1. Saha, Subir Kumar (2008) Introduction to Robotics, Tata McGraw-Hill Co. Ltd.

EME 431/3 – Refrigeration and Air Conditioning

Objective: To provide students with the basic concepts of refrigeration and air conditioning and their applications in daily life, building and industry.

Synopsis: The course is divided into refrigeration and air conditioning. The course introduces the application of refrigeration and air conditioning followed by principles of refrigeration cycles: vapor compression and vapor absorption cycle. Various types of refrigeration systems are elaborated. In air conditioning principles of thermal comfort and psychrometry are explained. Cooling load calculations are done via examples of typical building.

Course Outcome:

1. Able to explain various types of refrigerant and determine the performance of vapour compression cycles. Able to differentiate the various types of multi pressure systems and determine the performance of the system.
2. Able to differentiate between VCC and VAC and to determine the performance of VAC. Able to explain low temperature refrigeration system.
3. Able to list and explain other types of refrigeration systems. Able to design refrigeration system.
4. Able to explain the factors affecting human thermal comfort and determine the cooling load of building or room. Able to do psychometric analysis.
5. Able to list and explain with diagrams the various types of air conditioning systems. Able to calculate the air flow and duct size in ducting system.
6. Able to solve complex air conditioning problems. Able to calculate the air flow and duct size in ducting system.

Reference:

1. A. Ameen, Refrigeration & Air Conditioning, Eastern Economy Edition, Prentice Hall of India, 2006.
2. W.F. Stoecker and J.W. Jones, Refrigeration & Air Conditioning, TMH Edition, Tata McGraw-Hill Publishing Company, 1983.
3. E.G. Pita, Refrigeration Principles and Systems – An Energy Approach, John Wiley & Sons, Inc., 1984.
4. ASHRAE Handbook on Fundamentals, ASHRAE, 1997.

EME 451/3 – Computational Fluid Dynamics

Objective: To teach students to model and solve problems in fluid dynamics using various numerical techniques.

Synopsis: The goal of this course is to lay the foundations for the numerical solution of partial differential equations (PDE) and be able to perform computational simulation of PDE in fluid dynamics. By the end of this course, students will be able to classify a given set of PDE's and anticipate the sort of numerical difficulties that are associated with them, and apply numerical techniques to overcome the difficulties. Once the foundations have been

given to the students, they will use commercial CFD software (Fluent) to simulate real fluid dynamics problems.

Course Outcome:

1. To classify and synthesize types of PDE and various fluid dynamics models.
2. To analyze fluid dynamics models and discretization methods, and limitations with the models and discretization methods.
3. To design a computational fluid dynamics experiment via writing a computer code and using a commercial CFD software.
4. To solve real engineering fluid dynamics problems.

Reference:
1. D.A. Anderson, J.C. Tannehill, R.H. Pletcher, Computational Fluid Mechanics and Heat Transfer, McGraw-Hill.

EME 411/3 – Numerical Methods for Engineers

Objective: To introduce the application of finite element methods, finite volume and finite differential in solving engineering problems.

Synopsis: This course is an introductory course to the finite element method, finite different method and finite volume method, assisting the student to use MATLAB software and programming to solve various engineering problems.

Course Outcome:

1. Able to use finite different method in solving the engineering problems.
2. Able to use finite volume method in solving the heat and fluid problems.
3. Able to use finite element method to solve heat and structural problems.
4. Able to write a program in Matlab to solve problems using the above methods.

References:
1. Chapra, S and Canale, R. (2006) Numerical Methods for Engineers, McGraw-Hill
2. Farlow, S.J. (1982) Partial Differential Equation for Scientists and Engineers, John Wiley and Sons, Inc.

EPE 462/3 – Industrial Machine Vision

Objective: To offer knowledge on the application of machine visions in manufacturing machine.

Synopsis: This course has been designed to introduce to the students the basic concepts of machine vision and its application in the manufacturing industry. Starting from the generic machine vision system model, the students will learn how images are acquired, pre-processed and segmented before features are extracted from them. The Matlab Image Processing tool box will be used to demonstrate the fundamental and advanced image

processing operations, such as histogram equalization, binarization, filtering, morphological operations and region property measurement.

Course Outcome:

1. Ability to describe the various elements of a generic vision system model and explain how scene constraints can be applied to simplify the image processing operation.
2. Ability to explain the transformation of optical image data into an array of numerical data including its representation, sensing and digitization. Ability to capture an image from a scene into a computer using camera.
3. Ability to differentiate between point operations, global operations, neighbourhood operation, geometric operations and temporal operations.
4. Ability to partition an image into meaningful regions which correspond to part of objects within the scene.
5. Ability to extract features from images using image codes, boundary based features, region-based features and mathematical morphology.
6. Ability to use template matching method and neural network for pattern classification.

References:
1. Nello Zuech, Understanding and Applying Machine Vision, McGraw-Hill, 1996.
2. R.C. Gonzalez & R.E. Woods, Digital Image Processing. Addison-Wesley, 1993.
3. G.W. Awcock and R. Thomas, Applied Image Processing. McGraw-Hill, 1996.

EUP 222/3 – Engineers in Society
(Offered by the School of Civil Engineering)

Objective: To provide knowledge on ethics, management, law and financial accounting related to engineering industry and the related framework necessary for the effective conduct to the society and industry

Synopsis: This course provides basic exposure to the fundamentals principles of engineering ethics as well as engineering law that covers an introduction to the legislative system related to engineering projects such as environmental quality act and Occupational Safety and Health Act (OSHA). This course also provides basic exposure to the fundamental principles of economics and project finance related to engineering projects such as source of project funding and Net Project Value (NPV) as well as project management and engineering economics. Exposure of the project failure through actual case study will be thoroughly reviewed in this course.

Course Outcome:

1. Introduce the fundamental theoretical principles related to engineering ethics, basic law for engineers, engineering accounting and basic management.

2. Practice the real understanding on the fundamental theoretical principles related to engineering ethics, basic law for engineers, engineering accounting and basic management.
3. Appreciate the importance of the fundamental theoretical principles in actual construction industry

Reference:

1. Abdul Aziz Hussin & Abdul Rashid Abdul Aziz, Aspek Undang-Undang Tort dalam Projek Pembinaan, Pulau Pinang, Penerbit Universiti Sains Malaysia, 2000.
2. Akta Pendaftaran Jurutera dan Peraturan, 1967 (Pindaan Sehingga 1998).
3. J.R. Boatright, Ethics and The Conduct of Business, New Jersey, Prentice Hall, 2000.
4. J.R. Dyson, Accounting for Non-Accounting Students, London, Pitman Publishing, 1999.
5. Hairul Azhar Abdul Rashid, et., al., Engineers in Society, Kuala Lumpur, McGraw Hill, 2004.
6. W.T. Harrison and C.T. Horngren, Financial Accounting, New Jersey, Prentice-Hall, 2001.
7. Jaafar Muhamad, Asas Pengurusan, Petaling Jaya, Fajar Bakti, 1999.
8. J.D. Radford, The Engineer in Society, London, Macmillan, 1998.
9. S.P. Robbins and M. Coulter, Management, New Jersey, Prentice-Hall, 2004.
10. Shaik Mohd Noor Alam, Undang-undang Komersil Malaysia, Kuala Lumpur, Dewan Bahasa Pustaka, 1998.
11. M.G. Velasquez, Business Ethics, New Jersey, Prentice-Hall, 1998.
12. Wu Min Aun, Sistem Perundangan Malaysia, Petaling Jaya, Longman, 2000.

EMD 452/2 and EMD 452/4 – Final Year Project

Objective: To prepare students in handling individual projects which involve searching of reference material, analysis of theory, design and development of apparatus, experiments to obtain validity of theories, discussion and summary of results and writing a complete research report.

Synopsis: The final year projects provide a student the opportunities to apply knowledge acquired in the undergraduate study. The course runs for two semesters, with 2 unit in SEM-1 and 4 units in SEM-II. It aims at developing and measuring the capabilities of a student in mechanical engineering. The individual/group projects which are related to topics in mechanical engineering will involve searching of reference materials, analysis of theory (if needed), design and development of apparatus, experiment to verify the validity of theory, discussion and summary of results.

Course Outcomes:

1. Apply engineering principles to the design and development of the project.
2. Identify key issues and define problems through a project specification (utilising information acquired from literature searches and appropriate sources).
3. Identify and plan computational/experimental approaches to problem solving.
4. Plan and manage a project by disciplined work through self-imposed milestones and deadlines obtained by an analysis of relative workloads and task complexity within the problem at hand.
5. Carry out sound project analysis, research, engineering design, and problem solving, through the application of previously acquired competencies.
6. Work as an individual and/or participate as a member in teamwork.
7. Written communication developed through proposal/progress reports.
8. Oral communication by presentation developed through external interactions and project viva/presentations.

Reference: Books and journals collection in library.

EME 401/3 – Applied Finite Element Analysis

Objective: To improve the students' knowledge in finite element methods to ensure that they are capable to use commercial FEA software in analysis and engineering design effectively.

Synopsis: The course covers intermediate level knowledge of the finite element method (FEM). It equips students with the formulations of the FEM including discretization of a physical problem in a unified manner while emphasizing examples in solid mechanics and heat conduction. Analysis in discretization error with energy norm is discussed. The applications of the finite element analysis (FEA) in more complex engineering problems are taught by way of the commercial FEM package, ANSYS. A number of case studies are introduced to the students.

Course Outcome:

1. Able to formulate the FEM to solve by hand for simple problems in 1D using different element types.
2. Able to derive basis functions of 2-D elements, and the stiffness matrices and load vectors of the elements.
3. Able to evaluate discretization error with the energy norm formulation.
4. Able to competently model and solve complex engineering problems with available commercial FE packages.

References:
1. O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Elsevier Butterworth-Heinemann, 2005.
2. J.N. Reddy, An Introduction to the Finite Element Method, McGraw Hill, 2006.
3. K. J. Bathe, Finite Element Procedures, Prentice Hall, 1996.

EME 422/3 – Energy Conversion System

Objective: To offer the students the knowledge in various thermal power stations including the economic analysis of nuclear power and power stations in Malaysia. Also, to provide the idea on the important of the selection of energy sources.

Synopsis: The course introduces the types of fuels used in power plants: fossil, renewable and nuclear. The components of power plant are discussed in detail. Economic analysis and emission issues are also elaborated. Fuel cells, solar and biomass systems are discussed in detail.

Course Outcome:

1. Able to describe the types of fuel used
2. Able to identify the components and calculate the performance of a power plant
3. Able to perform economics analysis of power plant
4. Able to describe the types of fuel cell and nuclear power plants
5. Able to explain the emissions and control of pollutants
6. Able to do preliminary design of power plant

References:
1. W. Archie, Clup Jr. Principles of Energy Conversion, Singapore: McGraw Hill Book Co., 1985.
2. T.D. Eastop and McConkey, Applied Thermodynamics for Engineering Technologies, 4th ed., Longman, 1988.
3. B.S. Magne, Solar Power Engineering, New Delhi: McGraw Hill Publishing Co. Ltd., 1990.

EME 432/3 – Internal Combustion Engines

Objective: To study the principal of internal combustion engines, operation, performance and pollution.

Synopsis: The students should attain a fundamental understanding of the function of modern Internal Combustion Engines, including identification of each major component, knowledge of its function and how it relates to the other components in the engine. The student should also understand the basics of combustion chemistry, thermodynamics and heat transfer as applied to an ICE. Calculations of torque, power, efficiency, air/fuel ratio and fuel consumption will be required of students in the course. Finally an understanding of various new technologies in engine controls and their

relations to fuel economy, vehicle dynamics, cost and emissions will be required.

Course Outcome:

1. Capability of determining the appropriate amount for fuel (liquid or gas phase) for a given amount of air for various fuels, Emissions components determination and energy balance calculations.
2. Capability of determining power produced by actual engines based on typical specifications, and ability to compare efficiency and power from various size engines.
3. Ability to determine the type of air/fuel mixing appropriate for various engine types, and understand the tuning effects of an ICE and ramifications for and mitigation of the knock phenomenon.
4. Ability to calculate ignition delay, heat release, and indicated power for engine based on Cylinder Pressure. Relation between this and the gas flow, and it's effect on flame speed.
5. Calculate an engines performance, fuel consumption and quantity of pollutants based on given or typical engine characteristics for various technologies.
6. Ability to determine the appropriate intake and exhaust systems parameters (valve/port timings, runner lengths) appropriate for tuning optimization.
7. Ability to determine the appropriate intake and exhaust systems parameters (valve/port timings, runner lengths) appropriate for tuning optimization.

References:

1. S.R. Bell and R. Sekar, Natural Gas and Alternative Fuels for Engines, 1994.
2. R.S. Benson and N.D. Whitehouse, Internal Combustion Engines, Vol. 1 and Vol. 2, Oxford, England, Pergamon Press, 1983.
3. J.A. Caton and H.A. Webb, Cool-Fueled Diesel Engines, 1992.

EPE 482/3 – Optical and Surface Metrology

Objective: To expose students to the various methods of optical measurements such as interferometric (speckle, holographic, white light, phase shift etc.), fringe projection and moire method, as well as fringe analysis methods for shape, flatness, deformation, strain measurement and etc. The basic concepts involved in 2-D and 3-D surface measurement will also be presented.

Synopsis: Non-contact surface measurement based on optical methods are widely used in the industries for inspection, 3-D measurement, quality control, surface characterization and roughness measurement. Applications of optical surface measurement cover a wide ranges of industries such as data storage, wafer fabrication, MEMS, optical components, precision manufacturing etc. This course will introduce the underlying principles of optical 3-D measurement methods, their applications and the science of surface measurement.

Course Outcome:

1. Able to derive the general expression for the resultant electric vector of two interfering waves and determine the resulting intensity at a point.
2. Able to distinguish between wavefront division and amplitude division and give examples of interferometers based on each method.
3. Construct the optical layout of common interferometers and determine the phase difference between two interfering beams caused by a displacement.
4. Determine surface profile and strain from fringe patterns generated by various moire methods.
5. Develop and apply various image processing algorithms for processing digital images of fringe patterns.
6. Write algorithms to extract phase information from a series of fringe patterns.
7. Determine the various surface roughness parameters for a known profile and relate them to the functional features.

Reference: 1. K.J. Gasvik, Optical Metrology, Wiley, 2002.
2. D. Whitehouse, Surfaces and their Measurement, 2002

4.10 Program For Bachelor of Manufacturing Engineering With Management [Honours]

Type of course	Category	Level 100				Level 200				Level 300				Level 400			
		Semester 1	Semester Break	Semester 2	Long Vacation	Semester 1	Semester Break	Semester 2	Long Vacation	Semester I	Semester Break	Semester 2	Long Vacation	Semester 1	Semester Break	Semester 2	Unit
CORE	**Mathematics**	EUM 113/3 Engineering Calculus		EUM 114/3 Advanced Engineering Calculus		EMT 211/3 Engineering Probability & Statistics											
	Applied Mechanics			EMM 102/3 Statics		EMM 213/3 Strength of Materials		EMM 242/2 Dynamics									
	Thermal					EMH 211/3 Thermodynamics											
	Fluid			EMH 102/3 Fluid Mechanics													
	Controls	EEU 104/3 Electrical Technology		EMT 101/2 Numerical Computing		EMC 201/3 Measurement & Instrumentation				EMC 311/3 Mechatronic		EMC 322/3 Automatic Control		EPC 431/3 Robotic & Automation			
	Manufacturing Processes	EBB 113/3 Engineering Material				EPP 201/3 Manufacturing Technology 1		EPP 212/3 Advanced Manufacturing Technology		EPP 322/3 Advanced Manufacturing Process							
	Manufacturing Systems							EPM 212/3 Metrology & Quality Control		EPM 321/3 Manufacturing System		EPM 332/3 Industrial Engineering		EPM 451/3 Computer Integrated Manufacturing			
	Management			EPM 102/2 Engineering Economy				EUP 222/3 Engineers in Society		EPM 311/3 Engineering Management		EPM 342/3 Production Management					
	Design	EMD 101/2 Engineering Drawing		EMD 112/2 Conceptual Design & CAD				EPD 212/2 Product Design & Development		EPD 321/2 Design for Manufacturing		EPD 332/2 Tooling Design				EPD 442/4 Manufacturing Engineering Integrated Design	
	Practical	EML 101/2 Engineering Practice				EML 211/2 Engineering Laboratory I						EPL 322/2 Manufacturing Laboratory I		EPL 431/2 Manufacturing Laboratory II EPD 452/2 Final Year Project		EPD 452/4 Final Year Project	
	Total Unit	13		15		17		13		14		13	5	10		8	**108**

University Requirement		Malay Language (2 units)		Core Entrepreneurship (2 units)		English Language (2 units)		Ethnic Relation (2 units)		English Language (2 units)		Cocurriculum (3 units)						**15**
								Islamic & Asean Civilisations (2 units)										
ELECTIVE	**Manufacturing Processes**		**Semester Break**		**Long Vacation**		**Semester Break**		**Long Vacation**		**Semester Break**		**Long Vacation**	EPE 441/3 Micro and Nano Engineering	**Semester Break**	EPE 442/3 Advanced Semiconductor Manufacturing Technology		
																EPE 482/3 Optical and Surface Metrology		
	Manufacturing Systems													EPE 462/3 Industrial Machine Vision		EPE 401/3 Artificial Intelligence in Manufacturing		
	Management													EPE 421/3 Ergonomics and Industrial Safety		EPE432/3 Lean Six Sigma Manufacturing Management		
														EPE 431/3 Project Management				
	Total Unit	2		2		4		2		2		3		6/12		6/12		
	Grand Total Unit	15		17		21		15		16		16	5	16		14		**135**

4.10.1 Curriculum

LEVEL 100

			Total	Unit Lecture	Lab
SEMESTER I					
EMD	101/2	Engineering Drawing	2	0	2
EML	101/2	Engineering Practice	2	0	2
EEU	104/3	Electrical Technology	3	3	0
EBB	113/3	Engineering Materials	3	3	0
EUM	113/3	Engineering Calculus	3	3	0
			13	**9**	**4**
SEMESTER BREAK					
SEMESTER II					
EMT	101/2	Numerical Computing	2	2	0
EPM	102/2	Engineering Economy	2	2	0
EMH	102/3	Fluids Mechanics	3	3	0
EMM	102/3	Statics	3	3	0
EMD	112/2	Conceptual Design & CAD	2	0	2
EUM	114/3	Advanced Engineering Calculus	3	3	0
			15	**13**	**2**
LONG VACATION (13 weeks)					

LEVEL 200

			Total	Unit Lecture	Lab
SEMESTER I					
EMC	201/3	Measurement & Instrumentation	3	2	1
EPP	201/3	Manufacturing Technology I	3	3	0
EML	211/2	Engineering Laboratory I	2	0	2
EMH	211/3	Thermodynamics	3	3	0
EMT	211/3	Engineering Probability & Statistics	3	3	0
EMM	213/3	Strength of Materials	3	3	0
			17	**14**	**3**
SEMESTER BREAK					
SEMESTER II					
EPD	212/2	Product Design & Development	2	0	2
EPM	212/3	Metrology & Quality Control	3	3	1
EPP	212/3	Advanced Manufacturing Technology	3	2	1
EUP	222/3	Engineers in Society	3	3	0
EMM	242/2	Dynamics	2	2	0
			13	**10**	**4**
LONG VACATION (13 weeks)					

LEVEL 300

			Total	Unit Lecture	Lab
SEMESTER I					
EPM	311/3	Engineering Management	3	3	0
EMC	311/3	Mechatronic	3	1.5	1.5
EPD	321/2	Design for Manufacturing	2	0	2
EPM	321/3	Manufacturing System	3	3	0
EPP	322/3	Advanced Manufacturing Process	3	3	0
			14	**10.5**	**3.5**
SEMESTER BREAK					
SEMESTER II					
EPL	322/2	Manufacturing Laboratory I	2	0	2
EMC	322/3	Automatic Control	3	3	0
EPD	332/2	Tooling Design	2	0	2
EPM	332/3	Industrial Engineering	3	3	0
EPM	342/3	Production Management	3	3	0
			13	**9**	**4**
LONG VACATION (13 weeks) **EML 451/5 – Industrial Training**					

LEVEL 400

			Unit		
			Total	Lecture	Lab
SEMESTER I					
EPL	431/2	Manufacturing Laboratory II	2	0	2
EPC	431/3	Robotic and Automation	3	2.5	0.5
EPD	452/2	Final Year Project	2	0.5	1.5
EPM	451/3	Computer Integrated Manufacturing	3	3	0
			10	**6**	**4**
Elective					
EPE	421/3	Ergonomics and Industrial Safety	3	3	0
EPE	431/3	Project Management	3	3	0
EPE	441/3	Micro and Nano Engineering	3	2	1
EPE	462/3	Industrial Machine Vision	3	3	0
			12	**11**	**1**
SEMESTER BREAK					
SEMESTER II					
EPD	442/4	Manufacturing Engineering Integrated Design	4	0	4
EPD	452/4	Final Year Project	4	0	4
			8	**0**	**8**
Elective					
EPE	401/3	Artificial Intelligence in Manufacturing	3	3	0
EPE	442/3	Advanced Semiconductor Manufacturing Technology	3	2	1
EPE	482/3	Optical and Surface Metrology	3	3	0
EPE	432/3	Lean Six Sigma Manufacturing and Management	3	3	0
			12	**11**	**1**
LONG VACATION (13 weeks)					

4.10.2 Course – Programme Outcome Matrix

		Program Outcomes											
Level 100	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EMD 101-Engineering Drawing	1					√				√			
EML 101-Engineering Practices	1					√			√				
EUM 113 – Engineering Calculus	1	√	√										
EEU104 - Electrical Technology	1	√	√										
EBB 113 - Engineering Materials	1	√											
EMH 102- Fluid Mechanics	2	√	√										
EMM 102-Statics	2	√	√										
EMD 112-Conceptual Design and CAD	2		√	√		√				√			
EPM 102- Engineering Economy	2	√	√										√
EMT 101- Numerical Computing	2	√	√	√		√							
EUM 114 – Advanced Engineering Calculus	2	√	√										
Level 200	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EMT 211 - Engineering Probability and Statistics	1	√	√										
EMH 211-Thermodynamics	1	√	√										
EMM 213-Strength of Materials	1	√	√										
EML 211-Engineering Laboratory I	1	√			√					√	√		
EMC 201-Measurement System and Instrumentation	1	√	√										
EPP 201-Manufacturing Technology I	1	√	√					√					
EUP 222 - Engineers in Society	1	√		√			√		√		√		√
EPP 212-Advanced Manufacturing Technology	2		√	√		√							
EMM 242-Dynamics	2	√	√										
EPD 212 - Product Design & Development	2	√		√		√					√		
EPM 212- Metrology and Quality Control	2		√							√		√	
Level 300	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EMC 311-Mechatronics	1	√		√		√							
EPD 321- Design for Manufacturing	1		√	√						√	√		
EPM 321- Manufacturing System	1		√	√						√			
EPP 322-Advanced Manufacturing Processes	1		√		√			√					
EPM 311 - Engineering Management	1	√									√		√
EPL 322 - Manufacturing Laboratory I	2	√	√		√	√				√	√		
EPM 342-Production Management	2		√	√				√					
EPD 332-Tooling Design	2			√		√		√		√			√
EMC 322-Automatics Control	2			√	√								
EPM 322-Industrial Engineering	2			√			√						√
Level 400	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EPL 431 - Manufacturing Laboratory II	1	√	√		√	√				√	√		
EPM 451-Computer Integrated Manufacturing	1			√			√		√				
EPC 431-Robotics and Automation	1	√		√		√							
EPD 452-Final Year Project	1 & 2		√	√	√	√			√	√	√	√	
EPD 442 -Manufacturing Engineering Integrated Design	2	√	√		√	√	√		√	√	√		√
Elective Courses	**Sem**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
EPE 421-Ergonomik and Industrial Safety	1						√		√	√			
EPE 431-Project Management	1					√						√	√
EPE 432-Lean Six Sigma Manufacturing Management	2		√	√					√	√			
EPE 462-Industrial Machine Vision	1		√			√							
EPE 441 - Micro and Nano-Manufacturing Engineering	1				√		√		√				
EPE 442 - Advanced Semiconductor Manufacturing Technology	2			√				√				√	
EPE 401-Artificial Intelligence in Manufacturing	2		√	√		√							
EPE 482-Optical and Surface Metrology	2	√	√			√				√			

4.10.3 Course Description

EMD	101/2	Engineering Drawing
EML	101/2	Engineering Practice
EEU	104/3	Electrical Technology
EBB	113/3	Engineering Material
EUM	113/3	Engineering Calculus
EMT	101/2	Numerical Computing
EMH	102/3	Fluids Mechanics
EMM	102/3	Statics
EMD	112/2	Conceptual Design & CAD
EUM	114/3	Advanced Engineering Calculus

Refer to Mechanical Engineering Programme since the course contents are the same.

EPM 102/2 – Engineering Economy

Objective: To provide the basic tools of engineering economy so that students can carry out professional quality economic evaluations.

Synopsis: Interest, cash flow diagrams, investment balance equation, analysis of economic alternatives, (cost only and investment projects) using annual worth, present worth, and discounted cash flow. Effects of depreciation and income taxes. Economic optimization of engineering systems.

Course Outcome:

1. To explain principles of engineering economy
2. To describe different contemporary cost terminologies and apply cost estimation techniques in an integrated approach manner
3. To define and apply the concept of equivalence based on time value of money relationship for estimating the cash flows of the project
4. To conduct cash flow analysis on mutually exclusive projects under various practical scenarios
5. To understand and apply suitable methodologies to assess the impact on equivalent worth for an engineering project due to variability in selected factor estimates

Reference:

1. S. Kant Vajpayee, Fundamental of Economics for Engineering Technologist and Engineers, Prentice Hall, 2001.
2. William G. Sullivan, Elin M. Wicks and James Luxhoj, Engineering Economy, Prentice Hall, 2005.
3. G.J. Thuesen and W.J. Fabrycky, Engineering Economy, Prentice Hall, 2001.

EMC	201/3	Measurement & Instrumentation	Refer to Mechanical Engineering Programme since the course contents are the same.
EPP	201/3	Manufacturing Technology I	
EML	211/2	Engineering Laboratory I	
EMH	211/3	Thermodynamics	
EMT	211/3	Engineering Probability & Statistics	
EMM	213/3	Strengths of Materials	
EPM	212/3	Metrology & Quality Control	
EMM	222/4	Dynamics and Mechanisms	

EPD 212/2 – Product Design & Development

Objective: To provide a set of structured methodologies that can be used systematically in product design and development.

Synopsis: This course combines the perspective of marketing, design and manufacturing in product development. It is structured to expose students with various tools and techniques that can be put into immediate practice of design and development of product. It integrates the design principles and practices for good product design together with structured methodologies and procedures for designing and development of product.

Course Outcome:

1. Competence with a set of tools and methods for product design and development.
2. Confidence in your own abilities to create a new product
3. Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
4. Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
5. Enhanced team working skills.

Reference:

1. K.T. Ulrich and S.D. Eppinger, Product Design and Development, 3rd ed., McGraw Hill, 2003, ISBN: 0-7-229647-X.
2. E.G. Dieter, Engineering Design, 3rd ed., McGraw Hill, 2000, ISBN: 0-07-116204-6.
3. H.W. Stoll, Product Design Methods and Practices, Marcel Dekker, 1999, ISBN: 0-8247-7565-1.

EPP 212/3 – Advanced Manufacturing Technology

Objective: To introduce Machine Tool Technology used in modern manufacturing industries.

Synopsis: This course provides an overview of Machine Tool Technology with the emphasis on CNC Technology, advanced machining technologies for modern engineering material, rapid product development and rapid manufacturing.

Course Outcome:

1. Able to describe machine tools structure and its working principles and capabilities.
2. Able to write NC part programming to machine engineering component through conventional, manual and computer assisted programming.
3. Able to distinguish the role of CAD/CAM software and be able to apply them efficiently
4. Able to distinguish the working principles, process characteristics, process parameters and area of applications in advanced/non- traditional machining.
5. Able to describe and distinguish the various additive manufacturing processes (RP, laser metal forming) their capabilities and limitations for engineering applications

Reference:
1. S. Kalpakjan & S. Schmid, Manufacturing Engineering and Technology, 5th ed., Pearson Prentice Hall, 2006.
2. M.P. Groover, Fundamentals of Modern Manufacturing, John Wiley & Sons, 3rd ed., 2007.
3. J. A. Schey, Introduction to Manufacturing Processes, McGraw Hill, 1999.

EUP 222/3 – Engineers in Society
(Offered by the School of Civil Engineering)

Objective: To provide knowledge on ethics, management, law and financial accounting related to engineering industry and the related framework necessary for the effective conduct to the society and industry

Synopsis: This course provides basic exposure to the fundamentals principles of engineering ethics as well as engineering law that covers an introduction to the legislative system related to engineering projects such as environmental quality act and Occupational Safety and Health Act (OSHA). This course also provides basic exposure to the fundamental principles of economics and project finance related to engineering projects such as source of project funding and Net Project Value (NPV) as well as project management and engineering economics. Exposure of the project failure through actual case study will be thoroughly reviewed in this course.

Course Outcome:

1. Introduce the fundamental theoretical principles related to engineering ethics, basic law for engineers, engineering accounting and basic management.
2. Practice the real understanding on the fundamental theoretical principles related to engineering ethics, basic law for engineers, engineering accounting and basic management.
3. Appreciate the importance of the fundamental theoretical principles in actual construction industry

Reference:

1. Abdul Aziz Hussin & Abdul Rashid Abdul Aziz, Aspek Undang-Undang Tort dalam Projek Pembinaan, Pulau Pinang, Penerbit Universiti Sains Malaysia, 2000.
2. Akta Pendaftaran Jurutera dan Peraturan, 1967 (Pindaan Sehingga 1998).
3. J.R. Boatright, Ethics and The Conduct of Business, New Jersey, Prentice Hall, 2000.
4. J.R. Dyson, Accounting for Non-Accounting Students, London, Pitman Publishing, 1999.
5. Hairul Azhar Abdul Rashid, et., al., Engineers in Society, Kuala Lumpur, McGraw Hill, 2004.
6. W.T. Harrison and C.T. Horngren, Financial Accounting, New Jersey, Prentice-Hall, 2001.
7. Jaafar Muhamad, Asas Pengurusan, Petaling Jaya, Fajar Bakti, 1999.
8. J.D. Radford, The Engineer in Society, London, Macmillan, 1998.
9. S.P. Robbins and M. Coulter, Management, New Jersey, Prentice-Hall, 2004.
10. Shaik Mohd Noor Alam, Undang-undang Komersil Malaysia, Kuala Lumpur, Dewan Bahasa Pustaka, 1998.
11. M.G. Velasquez, Business Ethics, New Jersey, Prentice-Hall, 1998.
12. Wu Min Aun, Sistem Perundangan Malaysia, Petaling Jaya, Longman, 2000.

EMC	311/3	Mechatronic	Refer to Mechanical Engineering Program since the course contents are the same.
EMC	322/3	Automatic Control	
EPM	322/3	Industrial Engineering	

EPM 311/3 – Engineering Management

Objective: To introduce to engineering students how a company operates which include human resource management, marketing management, technology and innovation management, and financial management. The introduction of these aspects is to equip the students with decision making ability in their workplace.

Synopsis: The course involves the basic theory of human resource management, marketing management, technology management and innovation and financial management. This includes the topic of human resource planning, selection and recruitment, training, human resource development, marketing dimension, the behavior of buyers and marketing strategies, core competencies in technology and innovation management and financial analysis through various tools.

Course Outcome:

1. Able to understand and to identify the theory, principle, tools and capability related to human resource management, marketing management, technology and innovation management and financial management.
2. Able to identify and to apply appropriate management technique in diverse economic scenario and in facing current industrial trend.
3. Able to appreciate the importance of management theory and practice in carrying out workplace activities.

Reference:

1. Mathis R.L. and Jackson, J.H. (2013), Human Resource Management 14th edition, South Western Cengage Learning.
2. Kotler, P.T. and Keller K.L. (2011) , Marketing Management, 14th Edition, Prentice Hall.
3. Raymond, M., (2016), Financial Maangement Core Concept, Pearson.
4. Rastogi, P.N. (2009), Management of Technology and Innovation: Competing Through Excellence, 2nd Edition. Sage Publication.

EPD 321/2 - Design for Manufacturing

Objective: To involve students to the methodology for product redesign and development, the procedures to production documentations, actual fabrication and shop–floor metrology. To impart group dynamics experience and library and internet search experiences to the students. It also aims to educate students to prepare for verbal and writing communications.

Synopsis: This course is designed to involve students to the methodology for product redesign and development for manufacturability, the procedures to production documentations, actual fabrication and shopfloor metrology. To

impart group dynamics experience and library and internet search experiences to the students.

Course Outcome:

1. Able to select material and process.
2. Able to analyse product through value functional analysis, FAST and FMEA.
3. Able to redesign product economically through concept analysis, DFA and product redesign.
4. Able to apply and improve knowledge on technical drawing, tolerancing and GDT.
5. Able to prepare written communication using SOP and technical drawing and reports.

Reference:

1. David M. Anderson, Design for Manufacturability & Concurrent Engineering; How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, C I M Press, California, USA, 2010.
2. K.T. Ulrich & S.D. Eppinger, Product Design and Development. McGraw-Hill Int. ed., 1995.
3. John Wiley & Sons, Hindhede et al., Machine Design Fundamentals, NY, 1983.

EPM 321/3 – Manufacturing System

Objective: Describe both manufacturing and production system and the theories of their production control and scheduling. Review of the changes affecting the manufacturing and production system. Discussion of the important problems and directions for designing a factory.

Synopsis: This course provides an introduction to manufacturing system engineering. It is divided into two parts. In part one, an introduction to manufacturing system is given. Then, an overview of classification of manufacturing system, follow by production planning and control where it discussed the detail of plan and control of product to be produced on the shop floor. An introduction to the shop floor scheduling is given where it emphasis more on the scheduling method widely used on the shop floor such as the dispatching rule. Furthermore, a manufacturing system concept such as JIT, Lean Production and Agile Manufacturing is introduced. A detail discussion on the Group Technology and Cellular Manufacturing will conclude the first part of the course. Second part will focus on the technological concept; it will start by introduction to the major methodologies and concept of plant layout that is Single Station Manufacturing Cell, Manual Assembly Lines, Transfer Line and Similar Automated Manufacturing System and Automated Assembly Systems.

Course Outcome:

1. Able to distinguish the variety of manufacturing system existed.
2. Able to differentiate the methods and approach use in the manufacturing system operation
3. Able to plan and analyse single station manufacturing cells.
4. Able to plan and analyse single model and mixed model assembly line.
5. Able to plan and analyse automated production lines and automated assembly systems.

Reference:

1. M.P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, 2nd ed., Prentice Hall International Edition, 2001.
2. R.G Askin and C.R. Standridge, Modeling and Analysis of Manufacturing Systems, John Wiley and Sons, Inc., 1993.
3. J.T. Black, The Design of the Factory of The Future, McGraw Hill International Edition, 1991.

EPP 322/3 – Advanced Manufacturing Process

Objective: To expose students to non-metallic manufacturing processes, powder metallurgy, surface/finishing processes and also materials and process selection based on the design and economic factor.

Synopsis: This course describes the manufacturing process for non-metals (polymers, rubber, semiconductor, composites), powder metallurgy (raw materials, compaction and sintering), surface process (carbonizing, carbonitriding, ion implantation, electroplating), and materials and process selection.

Course Outcome:

1. Ability to identify and apply the processing techniques for polymeric, ceramics and glass materials in engineering applications
2. Ability to describe, identify and apply powder metallurgy technique to metallic materials
3. Ability to describe, identify and differentiate surface properties and defects, and applying various surface treatment methods in engineering problems
4. Ability to describe, identify and differentiate various semiconductor manufacturing processes and materials used.
5. Ability to describe and analyze MEMS processing methods, requirements and applications.

Reference:

1. S. Kalpakjan & S. Schmid, Manufacturing Engineering and Technology, 5th ed., Pearson Prentice Hall, 2006.
2. M.P. Groover, Fundamentals of Modern Manufacturing, John Wiley & Sons, 3rd ed., 2007.
3. J.A. Schey, Introduction to Manufacturing Processes, McGraw Hill, 1999.

EPL 322/2 - Manufacturing Laboratory I

Objective: To enhance the theoretical understanding of the materials, controls and manufacturing processes by performing related laboratory experiments.

Synopsis: This laboratory course covers fundamental topics in manufacturing such as casting, welding, metal forming, metrology, machining, materials investigation and automation (Programmable Logic Controller). Students will be able to apply the prior knowledge from other courses in solving engineering problems via laboratory experiments.

Course Outcome:

1. Able to describe the basic manufacturing processes and basic materials investigation
2. Able to analyse problems and propose solutions
3. Able to plan and conduct experiments for solving problems
4. Able to communicate effectively the experimental results technically

Reference:

1. S. Kalpakjan, Manufacturing Engineering and Technology, 3rd ed., Addison Wesley, 1995.
2. M.P. Groover, Fundamentals of Modern Manufacturing, Prentice-Hall, 1996.
3. J.A. Schey, Introduction to Manufacturing Processes, 2nd ed., McGraw-Hill Inc., 1987.

EPD 332/2 - Tooling Design

Objective: To provide the student with an understanding of the various aspects related to manufacturing engineering as practiced in the shop floor. The emphasis would be more in understanding the various concepts and background information related to the design of tooling.

Synopsis: The course starts with an introduction to the manufacturing processing requirements in industrial practice. The concepts of accuracy and errors of manufacturing are introduced with reference to the practical manufacturing processes. The importance of tooling in manufacturing will be related with the various design aspects related to some of the most widely used tooling such as jigs and fixtures, press tools, cutting tools, mould, die and welding jigs.

Course Outcome:

1. Able to determine the process and tooling required to manufacture a product.
2. Able to design the tooling based on the required product and manufacturing process.
3. Able to analyse or simulate the performance of the manufacturing process using the designed tooling.

4. Able to fabricate the required tooling using combination of manufacturing processes.
5. Able to inspect, test and evaluate the fabricated tooling.

Reference:
1. David Spitler, Fundamentals of Tool Design, 5th ed., Society of Manufacturing Engineers, 2003.
2. Prakash Hiralal Joshi, Jigs and Fixtures Design Manual, McGraw-Hill, 2002.
3. Donaldson, Lecain and Goold, Tool Design, McGraw Hill, New York, 1976.

EPM 342/3 – Production Management

Objective: To provide an understanding of the production function in manufacturing organizations. To study the methods related to the effective production planning and control.

Synopsis: To introduce and expose students to some of the basics management principles and techniques in the design, planning and control of production system. Part of this course is conducted via e-learning mode and the other part is done in conventional mode.

Course Outcome:

1. Able understand the objectives, functions and strategies practiced by manufacturing organizations in general
2. Able to use basic forecasting and decision making techniques in manufacturing
3. Able to appreciate various forms of production planning and control system and their usages and implications in the current manufacturing context
4. Able to conduct an ABC analysis, explain and use EOQ, POQ, quantity discount model and safety stock
5. Able to identify and prepare aggregate plan and MRP plan
6. Able to apply Gantt loading, scheduling charts, assignment method, priority sequencing rules, Johnson's rule and finite capacity scheduling.
7. Able to define and explain the lean concept in reduction of variability, flow time and waste.

Reference:
1. Stevenson, Production/Operations Management, Irwin, 1995.
2. Dilworth, Production and Operations Management, 1994.3.
3. E.E. Adam and R.J. Ebert, Production and Operations Management Concepts, Models and Behaviour, Prentice-Hall, 1993.

EPC 431/3 Robotic & Automation Refer to Mechanical

EPE	462/3	Industrial Machine Vision	Engineering Program since the course contents are the same.
EPE	482/3	Optical and Surface Metrology	

EPL 431/3 – Manufacturing Laboratory II

Objectives: To enhance the theoretical understanding of the manufacturing processes, machine technology, automation, and quality by performing related laboratory experiments.

Synopsis: The laboratory experiments are in the following fields: Quality & Reliability, machine tool technology, CNC machining, robotics and industrial automation, non-metallic material processing, rapid prototyping, automated inspection and non-conventional machining. The students are also trained to work in team and to write technical report. Experiments for related topics in

Course Outcome:

1. Able to measure sample using measuring instrument, construct *x* and *R* control chart and identify the process capability
2. Able to generate CAD model from scanned data by using Reverse Engineering technique.
3. Able to apply machine vision technology for quality inspection in manufacturing environment.
4. Able to use the appropriate fit and limit system for engineering component assembly
5. Able to utilise the FEA application software (ANSYS) to problem related to strength of materials and solid mechanic
6. Able to comprehend the effects of relevant rapid prototyping process parameters towards product quality
7. Able to analyse the capability of EDM process and the requirement of EDM in machining engineering component
8. Able to describe the process of plastic injection moulding and the critical process parameters to produce quality plastic parts
9. Able to appreciate the requirement of human energy to perform specific task in different environment and situation

Reference:

1. S. Kalpakjan, Manufacturing Engineering and Technology, 3rd ed., Addison Wesley, 1995.
2. M.P. Groover, Fundamental of Modern Manufacturing, Prentice-Hall, 1996.
3. J.A. Schey, Introduction to Manufacturing Process, 2nd ed., McGraw-Hill Inc.,1987.

EPM 451/3 – Computer Integrated Manufacturing

Objective: To stresses on utilization of computer to integrate manufacturing system including design, engineering analysis, production engineering, manufacturing planning and control and business management in an enterprise.

Synopsis: This course describes the utilization of computers to integrate manufacturing system. It covers the definition of computer integrated manufacturing (CIM), CIM elements, network and data communication, database, open system and standardization, product data exchange, numerical control technology, material transport system, storage system, automatic data capture and flexible manufacturing system.

Course Outcome:

1. Able to identified the element of CIM
2. Able to differentiate different network and data communication
3. Able to identified the data exchange and standard
4. Able to differentiate the technology and method use in CIM
5. Able to apply the technology and implement CIM in at small scale

Reference:

1. J.A. Rehg, Computer Integrated Manufacturing, Prentice Hall, 1994.
2. Groover, M. P. Automation, Production System, and Computer Integrated Manufacturing, 3rd Edition, Pearson, 2008, ISBN-9780132393218
3. Roger Hannam, Introduction to Computer Integrated Manufacturing, Addison – Wesley, 1997.

EPE 421/3 – Ergonomics and Industrial Safety

Objective: To introduce the importance of ergonomic and starts with the basic awareness on human body capability and also the working environment and then, provide the students with the ergonomic design based on the knowledge gain.

Synopsis: The first half of the course will introduce the importance of ergonomic and starts with the basic awareness on human body capability and also the working environment. The second half will concentrates on ergonomic design based on the knowledge gain from the first half.

Course Outcome:

1. Know the capability and capacity of the human body
2. Know the factors of concern in the working environment
3. Able to design jobs based on the human capability and capacity
4. Able to design workplace and work environment suitable for human
5. Able to design good interface between human and equipment

Reference:
1. Notes available in e-learning package.
2. E-book by the lecturer.
3. An Introduction to Human factors Engineering – Wickens, Lee, Liu and Becker Pearson-Prentiss Hall.

EPE 431/3 – Project Management

Objective: Introduction to the principles and techniques of planning, scheduling and monitoring of projects.

Synopsis: The course delivers the knowledge and technology pertaining to the modern project management, e.g. examining the organization, planning, and controlling of projects and provides practical knowledge on managing project scope, schedule and resources. The contents include project life cycle models, project scheduling, resource management, e.g. project budgeting and controlling. Throughout the course, the students are required to compose a project portfolio based on a real-life case study.

Course Outcome:

1. To differentiate the various organizational structure, able to make comparison and selection of the organizational structure.
2. To describe different elements in project planning and later systematically plan for a project.
3. To explain the notion of activities and precedence relations. From there, acquire the skill to construct PERT chart, CPM and Gantt chart.
4. To perform standard costing, budgeting and resource planning on project activities.
5. To evaluate and control project for monitoring of project performance.
6. To acquire the skill in using software to perform project management.

Reference:
1. Jeffrey K. Pinto, Project management: achieving competitive advantage, Pearson Education, 2007
2. Harold Kerzner, Project management-a system approach to planning, scheduling and controlling, John Wiley & Sons, Inc. 2003.
3. Heizer & Render, Operations Management, 10th edition, Pearson Education. 2010

EPD 442/4 – Manufacturing Engineering Integrated Design

Objective: The course will expose the student to the integrated design in manufacturing engineering with management practise, where all knowledge will be used to solve complex design problem and open ended solution. This course will emphasis on team-based project oriented. From the theory gained from all level of study, project need to apply engineering realistic constraint such as production and financial performance and also other issues related to safety, ethics and environment.

Synopsis: The goals of this course are to provide students with theoretical and practical knowledge for developing an efficient production system and to introduce some of the applications of tools and computer simulation in designing production system. The course will start with the introduction of production system and will lead the student through the collection, analysis and development of vital and relevant information to produce functional production system by considering all aspect including the financial.

Course Outcome:

1. Able to gain information related to manufacturing engineering sub-topic for project implementation.
2. Able to comply standards, acts and Malaysian regulation in designing production system.
3. Able to conduct parameters measurement/validation related to production system design capability.
4. Able to interact with team member in team working either as a leader or a member.
5. Able to carried out assessment regarding financial factor related to production system design project.
6. Able to prepare and perform presentation the integrated design report.

Reference:
1. Meyers, F.E. and Stephens, M.P., Manufacturing Facilities Design and Material Handling, 5th Edition, 2013
2. Micheal Pidd, Computer Simulation in Management Science, 5th Edition, John Wiley & Sons Inc. ISBN: 0470092300
3. Groover, M.P., Work Systems: Pearson New International Edition: The Methods, Measurement & Management of Work, 1st Edition, Pearson, 2013

EPD 452/2 and EPD 452/4 – Final Year Project

Objective: To prepare students in handling individual projects which involve searching of reference material, analysis of theory, design and development of apparatus, experiments to obtain validity of theories, discussion and summary of results and writing a complete research report.

Synopsis: The final year projects provide a student the opportunities to apply knowledge acquired in the undergraduate study. The course runs for two semesters, with 2 unit in SEM-1 and 4 units in SEM-II. It aims at developing and measuring the capabilities of a student in mechanical engineering. The individual/group projects which are related to topics in mechanical engineering will involve searching of reference materials, analysis of theory (if needed), design and development of apparatus, experiment to verify the validity of theory, discussion and summary of results.

Course Outcomes:

1. Apply engineering principles to the design and development of the project.
2. Identify key issues and define problems through a project specification (utilising information acquired from literature searches and appropriate sources).
3. Identify and plan computational/experimental approaches to problem solving.
4. Plan and manage a project by disciplined work through self-imposed milestones and deadlines obtained by an analysis of relative workloads and task complexity within the problem at hand.
5. Carry out sound project analysis, research, engineering design, and problem solving, through the application of previously acquired competencies.
6. Work as an individual and/or participate as a member in teamwork.
7. Written communication developed through proposal/progress reports.
8. Oral communication by presentation developed through external interactions and project viva/presentations.

Reference: Books and journals collection in library.

EPE 401/3 – Artificial Intelligence in Manufacturing

Objective: To provide an introduction to the field of Artificial Intelligence. It will cover the history of AI (its revival in the 80's), various branches of AI and current research efforts in the field.

Synopsis: This course presents the theory artificial intelligence, and application of the principles of artificial intelligence to problems that cannot be solved, or cannot be solved efficiently, by standard algorithmic techniques using Knowledge representation and Knowledge-based systems.
Topics include search strategies, production systems, heuristic search and expert systems. An artificial intelligence language is utilised as a vehicle for implementing concepts of artificial intelligence.

Course Outcome:

1. To describe the recent developments of artificial intelligence including classifications and applications in manufacturing engineering.
2. To design & apply Rule-based expert systems in problem solving.
3. To design & apply Fuzzy expert systems in problem solving.
4. To apply and modify neural networks, either multilayer perceptons or winner-take-all networks for problem solving.
5. To implement uninformed search, heuristic search and genetic algorithms for state space search problem domain.
6. To acquire the skill in using software to perform AI.

Reference:
1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd ed., Prentice Hall, 2003, ISBN 0130803022.
2. N. Nilsson, Artificial Intelligence - A New Synthesis, Morgan Kaufmann, 1998.

3. E. Rich and K. Knight, Artificial Intelligence, 2nd ed., McGraw Hill, 1991, ISBN: 0-07-052263-4.

EPE 441/3 – Micro and Nano Manufacturing Engineering

Objective: Cross-disciplinary course is to introduce students to micro and nano engineering and its importance to future economic growth. Students will be introduced to the basics of the science of micro-and nano-products prior to application engineering. This exposure will open the door for the creation of micro-devices and nano for use in the future.

Synopsis: This trans-disciplinary course covers the foundation of the micro and nano engineering and its importance for future device fabrication. Students will be introduced to the basics of micro and nano sciences before being introduced to its engineering applications. These exposures will open the way for the creation of micro and nano scale devices for future use.

Course Outcome:

1. Students will be able to identify the foundations of micro and nano, and differentiate between sciences, engineering and technology at micro and nano scales.
2. Students will be able to identify, design and synthesis the device fabrication processes to achieve certain profile structure on certain substrate materials.
3. Students will be able to identify and describe the processes and tools involved in the fabrication and characterization of micro and nano devices.
4. Students will be able to clearly describe and demonstrate the methods or procedures of fabricating micro and nano devices such as MEMS/NEMS, Biochips, Microfluidics and electronics.
5. Students will be able to comprehend the impact of micro and nano technology in society.

Reference:
1. Stephen A. Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press, 2001
2. Gary S. May, Simon M. Sze, "Fundamentals of Semiconductor Fabrication", John Wiley & Sons, 2004
3. Chang Liu, "Foundation of MEMS", Prentice Hall, 2006

EPE 442/3 – Advanced Semiconductor Manufacturing Technology

Objective: To introduce students to the advanced manufacturing technology in the semiconductor industry, starting with wafer manufacturing, fabrication processes, assembly and testing of electronic packages and installation package on the circuit board.

Synopsis: This course covers the foundation of electronic devices such as semiconductor physics and device design. It also covers basic topics of manufacturing processes in semiconductor industry such as wafer manufacturing, device fabrication process, assembly and packaging of device packaging as well as mounting the device packaging onto the circuit board. The developed knowledge from this course could be used in the fabrication of non-electronic devices such as MEMS/NEMS, bio-chip, optical and microfluidics.

Course Outcome:

1. Students will be able to identify the foundations of semiconductor technology such as technology roadmap, semiconductor physics and device design.
2. Students will be able to identify and describe the manufacturing processes and tools involved in the wafer manufacturing and the fabrication of semiconductor devices. Manufacturing Level 0.
3. Students will be able to identify and describe the manufacturing processes and tools involved in the assembly and test of electronic component manufacturing. Manufacturing Level 1.
4. Students will be able to identify and describe the manufacturing processes and tools involved in the system/board manufacturing using Surface Mount Technology (SMT). Manufacturing Level 2.
5. Students will be able to comprehend the impact of the future of advanced semiconductor technology to the society.

Reference:

1. Stephen A. Campbell, " The Science and Engineering of Microelectronic Fabrication", Oxford University Press, 2001
2. Michael Quirk, Julian Serda, " Semiconductor Manufacturing Technology", Prentice Hall, 2001
3. Gary S. May, Simon M. Sze, " Fundamentals of Semiconductor Fabrication", John Wiley &Sons, 2004.
4. Simon M. Sze and Kwok K. Ng, " Physics of Semiconductor Devices, John Wiley & Sons, 2007.
5. Chang Liu, "Foundation of MEMS", Prentice Hall, 2006.
6. Simon M. Sze and Kwok K. Ng, " Physics of Semiconductor Devices, John Wiley &Sons, 2007.
7. Frank Classon, "Surface Mount Technology for Concurrent Engineering and Manufacturing", McGraw-Hili, 1993.

EPE 432/3 – Lean Six Sigma Manufacturing Management

Objective: To introduce and enhance student understanding lean six sigma concept and method and its usage in the manufacturing and service area.

Synopsis: This course introduces students to lean manufacturing and six sigma, tools and techniques. It provides practical knowledge on the wider implications of organization management and implementations of lean manufacturing and six sigma on real shop floor. The course also imparts to students on how the underpinning philosophies, methods and practices have influenced manufacturing firms in terms of competency focus, organization thinking and structure, business value adding system and positioning. Lean manufacturing emphasizes on concerted effort by the whole organization to achieve business sustainability by continuously perfecting the alignment of company competency systematically identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes. Well recognized tools from lean manufacturing and six sigma including just-in-time (JIT), lean supply chain, single minute exchange of die (SMED), level scheduling, Kanban system, Ohno's wastes, statistical process control, total productive maintenance (TPM), poka-yoke, jikoda and 5S will be explored in this course.

Course Outcome:

1. Able to explain philosophical, organizational and cultural to support Lean Six Sigma in both manufacturing and service context.
2. Able to understand and use Lean Six Sigma tools in correct way.
3. Able to understand and use Lean Sic Sigma system systematically to solve complex problem.
4. Able to understand and use level stage management method and continuous improvement and to sustain and completing solution.

Reference:

1. Lean Six Sigma: Combining Six Sigma Quality with Lean Production Speed, Michael George, McGraw-Hill, 2002.
2. What is Lean Six Sigma, Michael George, David Rowlands and Bill Kastle, McGraw-Hill, 2004.
3. BOSE Lean Enterprise Yellow Belt Module
4. Creating a Lean Culture: Tools to Sustain Lean Conversions, David Mann, Productivity Press, 2005.
5. The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, Jerry Liker, McGraw-Hill, New York, 2004.
6. The Toyota Way Fieldbook, Jeffrey Liker and David Meier, McGraw-Hill, 2006.

COURSE INDEX **PAGE**

EMD	101/2	Engineering Drawing	63
EML	101/2	Engineering Practice	65
EMT	101/2	Numerical Computing	70
EMM	101/3	Engineering Mechanics	63
EPM	102/2	Engineering Economy	108
EMH	102/3	Fluids Mechanics	71
EMM	102/3	Statics	72
EEU	104/3	Electrical Technology	66
EMD	112/2	Conceptual Design and CAD	71
EBB	113/3	Engineering Materials	67
EUM	113/3	Engineering Calculus	68
EUM	114/3	Advanced Engineering Calculus	73
EPP	201/3	Manufacturing Technology I	75
EMC	201/3	Measurement and Instrumentation	74
EML	211/2	Engineering Laboratory I	76
EMH	211/3	Thermodynamics	77
EMT	211/3	Engineering Probability and Statistics	77
EPD	212/2	Product Design & Development	109
EMT	212/3	Computational Engineering	79
EPP	212/3	Advanced Manufacturing Technology	110
EPM	212/3	Metrology and Quality Control	79
EMM	213/3	Strength of Materials	78
EUP	222/3	Engineers in Society	110
EUP	222/3	Engineers in Society	96
EMH	222/3	Fluids Dynamics	80
EMM	242/4	Dynamics	81
EMD	223/2	Machine Component Design	82
EUP	301/3	Engineering Management I	112
EMT	302/3	Mathematical Modelling in Engineering	86
EMC	311/3	Mechatronic	82
EPD	321/2	Design for Manufacturing	112
EPM	321/3	Manufacturing System	113
EPL	322/2	Manufacturing Laboratory I	115
EMC	322/3	Automatic Control	87

EPP	322/3	Advanced Manufacturing Process	114
EPM	322/3	Industrial Engineering	88
EML	331/2	Engineering Laboratory II	83
EMM	331/3	Solid Mechanics	84
EPP	331/4	Manufacturing Technology II	85
EPD	332/2	Tooling Design	115
EMD	332/2	Machine Design	87
EMH	332/3	Applied Thermodynamics	85
EML	342/2	Engineering Laboratory III	89
EPM	342/3	Production Management	116
EMM	342/3	Noise and Vibration	89
EPE	401/3	Artificial Intelligence in Manufacturing	121
EME	401/3	Applied Finite Element Analysis	98
EME	411/3	Numerical Method for Engineers	94
EPE	421/3	Ergonomics and Industrial Safety	118
EME	422/3	Energy Conversion System	98
EPL	431/3	Manufacturing Laboratory II	117
EPE	431/3	Project Management	119
EPC	431/3	Robotic and Automation	92
EME	431/3	Refrigeration and Air Conditioning	93
EPD	432/3	Lean Six Sigma Manufacturing Management	124
EME	432/3	Internal Combustion Engines	99
EMH	441/3	Heat Transfer	90
EPE	441/3	Micro and Nano Manufacturing Engineering	122
EPD	442/4	Manufacturing Engineering Integrated Design	120
EMD	431/4	Mechanical Engineering Integrated Design	91
EPE	442/3	Advanced Semiconductor Manufacturing Technology	123
EPM	451/3	Computer Integrated Manufacturing	118
EME	451/3	Computational Fluid Dynamics	94
EMD	452/2 452/4	Final Year Project	97
EPD	452/2 452/4	Final Year Project	121
EPE	462/3	Industrial Machine Vision	95
EPE	482/3	Optical and Surface Metrology	100

STUDENT'S FEEDBACK

The aim of this feedback form is to obtain students' response regarding the contents of this Guidebook. The information obtained will be useful for continual improvement.

Please respond to items 1 – 5 below based on the following 4-point scale:

1 = Strongly disagree	2 = Disagree	3 = Agree	4 = Strongly agree

1. This Guidebook is very useful.

1	2	3	4

2. The information provided in this Guidebook is accurate.

1	2	3	4

If you choose 1 or 2 for Question no. 2, please state the page number that contains information that is inaccurate in the space below:

3. The information provided in this Guidebook is clear and easy to understand.

1	2	3	4

4. On the whole, the quality of this Guidebook is good.

1	2	3	4

5. I prefer to use the CD that is provided compared to this Guidebook.

1	2	3	4

6. If you think other information should be included to make this Guidebook better, please write your suggestions in the space below:

Please submit this feedback form to your School's General Office in the 4th week of Semester I, Academic Session 2017/2018.

This booklet is meant for new students for new Academic Session of 2017/2018. University and School have the right to change the content without prior notice.

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