ACADEMIC HANDBOOK SESSION 2021/2022
FOR BACHELOR DEGREE PROGRAMME
(PART TIME MODE)
FACULTY OF MECHANICAL ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

All information in this academic handbook is correct at the time of print and subject to change without prior notice.

Further enquiries please refer to:

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ACKNOWLEDGEMENT

FOREWORD BY THE DEAN

In the name of Allah, Most Beneficial, Most Merciful
Assalammualaikum and Salam Sejahtera,

First and foremost, I would like to welcome all new students to the Faculty of Mechanical Engineering (FKM), Universiti Teknikal Malaysia Melaka (UTeM). Congratulations on being enrolled on our engineering programmes. You have made the right decision to prepare you to be a skilled and competent engineer with commendable leadership qualities.

The objective of this academic handbook is to be a reference for students to understand and get to know the faculty and the programmes offered at FKM. Thus, students are exposed to the world of knowledge, competency, and skills blended together to develop their self-esteem in philosophy, creativity, and critical thinking and strengthen their commitments in serving the country. It is also aimed to equip students to be well-prepared in facing real-world challenges to survive in their future careers. Therefore, we are looking forward to producing Agile, Superior, Adaptive and Holistic graduates, more commonly known as "*Tangkas, Unggul, Adaptif dan Holistik* (TUAH)" herein UTeM.

In the context of professional graduates, our faculty provides various facilities for students in developing their skills and self-competency. For example, *Research Power House* aims to educate and instil research practices that will prepare our graduates to pursue further studies at the postgraduate level. Furthermore, our continuous effort in preparing a series of demand-driven laboratories to serve our partners from both the industry and agencies is another step forward in creating a dynamic R&D environment at FKM, in line with the national policy towards supporting the IR4.0 ecosystem. In addition, FKM also provides courses and vocational competency

certificates to prepare students as work-ready graduates who will be the expert group for the workforce.

Since 2020, the COVID-19 virus has turned the world and our country in crisis. As a result of this pandemic, the implementation of teaching and learning (T&L) must be done entirely online and hybrid over the past few semesters. As a result, there have been several changes in the implementation of lectures, laboratory training, and practical works and examinations. However, this implementation is subject to the EAC guidelines and may change from time to time. Therefore, we hope that lecturers and students are always ready and resilient in facing any changes and implementation of T&L during the study period.

The COVID-19 pandemic has caused direct impacts, particularly on the country's economic sector and, in our context, the higher education sector. Therefore, various initiatives have been undertaken by the Ministry of Higher Education (MOHE) and the university management. The teaching and learning process is done online to ensure that academic sessions continue without delay and the main goals of holistic and inclusive learning are achieved.

Undoubtedly it is not easy for graduates to adapt to new norms, which turns out to be challenging. In reality, among the main challenges faced by students are poor internet access at home, especially for those living in rural areas, personal issues such as the dilemma between giving total commitment to online learning vs. financial struggles faced in many households thus demanding the students to either help their family with household chores or find part-time jobs to survive. For some, the inability to access online T&L is due to unavailability of smartphones and devices. This have also been their primary concern due to poor financial wellbeing. In FKM and UTeM, we are working on ways to tackle these issues prudently and are continuously taking proactive measures to ensure that no student is left behind throughout their studies, especially during this challenging time where the whole nation and worldwide is fighting in a war against the pandemic.

Hence, I strongly hope that this academic handbook will benefit our students as a helpful guide throughout their studies at FKM and UTeM. Lastly, I would like to wish all our upcoming and current students all the best to embark on this faculty journey.

"FKM - GEARED FOR EXCELLENCE"

Thank you.

Dr. Ruztamreen Bin Jenal
Dean
Faculty of Mechanical Engineering

1 BACKGROUND OF UTeM

1.1 History

On December 1st, 2000, the Ministry of Education of Malaysia has officially approved the establishment of a new public university in the name of Kolej Universiti Teknikal Kebangsaan Malaysia (KUTKM). The establishment of KUTKM is to fulfil the needs of prospective industries on professional manpower in technical areas that not only have sound academic ability, but also competent and highly technical skilled. As the 14th public higher learning institution established in Malaysia, KUTKM has experienced many challenges and impediments in order to be a renowned university. KUTKM supports application-oriented approach and practice in its Teaching and Learning (T&L) processes.

On February 1st, 2007, KUTKM has been renamed and presently known as the Universiti Teknikal Malaysia Melaka (UTeM). From the beginning of the establishment, UTeM has upheld and maintained technical education programmes which fulfil the needs of current industries and tech-based employers. The students of UTeM come from diverse backgrounds which include science, technical and vocational streams.

1.2 Vision, Mission, Motto and Educational Goals

The vision, mission, motto and educational goals of UTeM are as follows:

1.2.1 Vision

To Be One of the World's Leading Innovative and Creative Technical Universities

1.2.2 Mission

UTeM is determined to lead and contribute to the wellbeing of the country and the world by:

a. Promoting knowledge through innovative teaching & learning, research and technical scholarship;
b. Developing professional leaders with impeccable moral values;
c. Generating sustainable development through smart partnership with the community and industry."

1.2.3 Motto

Excellence Through Competency

1.2.4 Educational Goals

a. To conduct academic and professional programmes based on relevant needs of the industries.
b. To produce graduates with relevant knowledge, technical competency, soft skills, social responsibility and accountability.
c. To cultivate scientific method, critical thinking, creative and innovative problem solving and autonomy in decision making amongst graduates.
d. To foster development and innovation activities in collaboration with industries for the prosperity of the Nation.
e. To equip graduates with leadership and teamwork skills as well as develop communication and life-long learning skills.
f. To develop technopreneurship and managerial skills amongst graduates.
g. To instill an appreciation of the arts and cultural values and awareness of healthy life styles amongst graduates.

1.3 Location

From 2001 to 2005, UTeM, which was then known as KUTKM, was located in renovated shophouses in Taman Tasik Utama, Ayer Keroh. These renovated shophouses consist of the university administrative offices, lecture halls, laboratories, staff rooms along with student accommodation.

On June 10th, 2001, KUTKM began offering academic programmes with pioneer student intake of 348 students. At present, UTeM has eight faculties and one post graduate (PG) centre that offer programmes at Diploma, Bachelor Degree or PG levels. The faculties are:

a. Faculty of Mechanical Engineering (FKM)
b. Faculty of Electronics & Computer Engineering (FKEKK)
c. Faculty of Electrical Engineering (FKE)
d. Faculty of Manufacturing Engineering (FKP)
e. Faculty of Information & Communication Technology (FTMK)
f. Faculty of Technology Management & Technopreneurship (FPTT)
g. Faculty of Mechanical & Manufacturing Engineering Technology (FTKMP)
h. Faculty of Electrical & Electronic Engineering Technology (FTKEE)
i. Centre of Graduate Studies (PPS)

UTeM has 2 campuses; which are the Main Campus at Durian Tunggal and Technology Campus at Ayer Keroh.

1.3.1 Main Campus

The Main Campus is located at the Mukim Durian Tunggal, Melaka on a piece of land that has been developed since 2001. The Faculty of Electronics & Computer Engineering and the Faculty of Electrical Engineering have commenced their operations at the Main Campus since 2005. In 2009 another three faculties, namely the Faculty of Mechanical Engineering, the Faculty of Manufacturing Engineering and the Faculty of Information & Communication Technology, started operating in the main campus. However, in 2011, Faculty of Mechanical Engineering was relocated at the Technology Campus, Ayer Keroh. In addition, Institute of Technology Management & Entrepreneurship (IPTK), Centre for Languages and Human Development (PBPI), the Sports Complex, the Student Activity Centre and students' cafeteria are completed and utilized. Sports grounds such as fields for football, hockey, tennis and various other sports facilities are also available at the Main Campus. The university administrative offices have been fully operational

since 2010 at the Main Campus; such as the Chancellery, Registrar, Bursary, Knowledge and Communication Services Centre, Centre for Academic Excellence and Scholarship, Centre for Strategic, Quality and Risk Management, University Press, Laman Hikmah Library, Grand Hall and Sayyidina Abu Bakar Mosque.

1.3.2 Technology Campus

The Technology Campus is located in Kawasan Perindustrian Tasik Utama, Ayer Keroh which houses the Faculty of Mechanical Engineering (FKM), Faculty of Mechanical & Manufacturing Engineering Technology (FTKMP), Faculty of Electrical & Electronic Engineering Technology (FTKEE) and Institute of Technology Management and Entrepreneurship (IPTK). Most of FKM's laboratories are located at the Mechanical Engineering Laboratory Complex (F5), Technology Campus.

1.4 University Organization

In 2004, UTeM revamped its structure of organization. New departments were established including the Centre for Teaching & Learning (PPP), Centre for Graduate Studies (PPS), and Centre for Quality Assurance & Accreditation (PJKA) which is now known as Centre for Strategic, Quality & Risk Management (PPSKR). In 2008, several other centres were opened including Centre for Languages & Human Development (PBPI), Sports Centre, and Islamic Centre.

The university's organization consists of the University's Senate and the University Executive Council. In 2010, there are improvements on the university's structure of organization. Shown in **Figure 1.1** is the current organization structure of UTeM top management with the 1st female vice chancellor of UTeM, appointed in June, 2019.

PROF. IR. DR. GHAZALI BIN OMAR

ACTING VICE CHANCELLOR

PROF. DR. ZULKIFLIE BIN IBRAHIM

DEPUTY VICE CHANCELLOR (ACADEMIC & INTERNATIONAL)

PROF. IR. DR. GHAZALI BIN OMAR

DEPUTY VICE CHANCELLOR (RESEARCH & INNOVATION)

ASSOC. PROF. DR. NURULFAJAR BIN ABD MANAP

DEPUTY VICE CHANCELLOR (STUDENT AFFAIRS)

ASSOC. PROF. TS. MOHD RAHIMI BIN YUSOFF

ASSISTANT VICE CHANCELLOR (DEVELOPMENT & FACILITY MANAGEMENT)

ASSOC. PROF. IR. DR. MD NAZRI BIN OTHMAN

ASSISTANT VICE CHANCELLOR (INDUSTRY & COMMUNITY)

MR. MASDZARIF BIN MAHAT

CHIEF OPERATING OFFICER

MR. KHAIRUL BIN TAIB

BURSAR

MR. MOHD ISA BIN MOHD DOM

CHIEF INFORMATION OFFICER

DATUK AZHAR BIN MOHAMED

LEGAL ADVISOR

Figure 1.1 UTeM Top Management

The lists of departments are listed below:

a. Administration :
   i. Chancellory
   ii. Deputy Vice Chancellor (Academic & International) Office
   iii. Deputy Vice Chancellor (Research & Innovation) Office
   iv. Deputy Vice Chancellor (Student Affairs) Office
   v. Assistant Vice Chancellor (Industry & Community) Office
   vi. Registrar

vii. Bursary
viii. Chief Information Officer Office

b. Academic :

i. Centre for Graduate Studies
ii. Faculty of Electronics & Computer Engineering
iii. Faculty of Electrical Engineering
iv. Faculty of Mechanical Engineering
v. Faculty of Manufacturing Engineering
vi. Faculty of Information & Communication Technology
vii. Faculty of Technology Management & Technopreneurship
viii. Faculty of Mechanical & Manufacturing Engineering Technology
ix. Faculty of Electrical & Electronic Engineering Technology
x. Centre for Languages & Human Development
xi. Institute of Technology Management & Entrepreneurship

1.5 Academic Calendar

The Academic Calendar for each session can be accessed from UTeM website.
https://www.utem.edu.my/academic-calendar.html

2 BACKGROUND OF FKM

2.1 Introduction

The Faculty of Mechanical Engineering (FKM), UTeM was established after the approval was granted by the Ministry of Education Malaysia on the 22nd June 2001. The faculty administration office and lecture rooms are located in Technology Campus, Taman Tasik Utama, Ayer Keroh. A laboratory complex nearby was built to host the laboratories, workshops and lecture rooms. Complete locations of facilities can be referred in **Tables 7.1-7.3**. Currently, the faculty offers both undergraduate and postgraduate programmes. The undergraduate programmes offered are Diploma in Mechanical Engineering (DMC), Bachelor of Mechanical Engineering with Honours (BMCG) and Bachelor of Automotive Engineering with Honours (BMCK) programmes whilst the post graduate programmes are Master of Science by research, Master of Mechanical Engineering (Taught Course), Doctor of Philosophy (PhD) and Doctor of Engineering (D.Eng) programmes. Bachelor of Mechanical Engineering with Honours (BMCG) programme was offered in part time mode since semester 2 session 2017/2018.

2.2 Vision, Mission and Objectives

In order to achieve the objectives of the Faculty, a framework of policy implementation is developed. The followings are the vision, mission and objectives of programmes offered by the Faculty.

2.2.1 Vision

To be an ideal, dynamic and innovative faculty.

2.2.2 Mission

To produce highly competent mechanical engineering graduate having good moral and ethical values.

2.2.3 Objectives

a. To offer high quality academic programmes with emphasis on practice and application oriented mechanical engineering discipline in line with the current industrial requirement and be recognized by professional bodies.
b. To produce competent mechanical engineering graduate with critical thinking, innovative and have the ability to solve problem either in group or individual in the process of fulfilling the national human capital requirement.
c. To upgrade expertise and competency of the staff by conducting various quality and well organized human resource development programmes based on good ethical and moral values.
d. To perform the research and development activities based on industrial problems in the process to develop post-graduate programmes and to produce prototypes that could be patented and commercialized.
e. To conduct teaching and learning based on writing and publication activities as well as research and consultancy activities.
f. To promote smart partnership between university and industry at faculty level.
g. To offer services in consultancy and life-long learning with practical and application oriented in the field of mechanical engineering and in other strategic field or specialization to meet the requirement of domestic and global market.

2.3 Faculty Organization

The faculty administration is headed by a Dean and assisted by three Deputy Deans who are responsible in academic, research & postgraduate studies and student development. Departments are managed by Head of Department. Currently FKM has two departments, namely Department of Mechanical Engineering, and Department of Diploma Studies. Each Head of Department is entrusted and is responsible for the academic activities and physical development of the infrastructure and facilities. There are also programme coordinators who assist further in management of academic and postgraduate programmes.

The research activities are coordinated by the Research Coordinator to manage the Centre of Excellence (CoE). The CoE for FKM is known as the Centre for Advanced Research on Energy (CARe). **Figure 2.1** shows the current FKM top management. The Administrative Office of FKM is located at Level 3 FKM Building, Technology Campus, where the office of Dean, Deputy Deans, Head of Departments, Chief Assistant Registrar, Assistant Registrar and administrative support staffs are located. The management of laboratories at FKM is handled by a Lab Coordinator. The complete FKM organization structure is shown in **Figure 2.2**.

The management of the Mechanical Engineering (BMCG) Part Time Programme involves Lifelong Learning Center (PPSH) as shown in **Figure 2.3**. The part time programme was managed by Academic Coordinator from the Faculty and Administrative Coordinator from Lifelong Learning Center (PPSH). Academic Coordinator responsible on academic matters and act as an academic advisor to the part time student. While, Administrative Coordinator responsible on administrative and financial management for part time students. The Academic and Administrative Coordinator for BMCG Part Time Programme is shown in **Figure 2.4**.

DR. RUZTAMREEN BIN JENAL

DEAN

ASSOC. PROF. DR. MOHD FADZLI BIN ABDOLLAH

DEPUTY DEAN
(ACADEMIC)

DR. MOHD AFZANIZAM BIN MOHD ROSLI

DEPUTY DEAN
(RESEARCH & POSTGRADUATE STUDIES)

DR. NADLENE BINTI RAZALI

DEPUTY DEAN
(STUDENT DEVELOPMENT)

DR. FAIZ REDZA BIN RAMLI

HEAD OF DEPARTMENT
(MECHANICAL ENGINEERING)

DR. NURHIDAYAH BINTI ISMAIL

HEAD OF DEPARTMENT
(DIPLOMA STUDIES)

DR. JUFFRIZAL BIN KARJANTO

PROGRAMME COORDINATOR
(MECHANICAL ENGINEERING)

TS. DR. MUHD RIDZUAN BIN MANSOR

PROGRAMME COORDINATOR
(POSTGRADUATE STUDIES)

DR. FAIZUL AKMAR BIN ABDUL KADIR

PROGRAMME COORDINATOR
(AUTOMOTIVE ENGINEERING)

DR. MOHD ADRINATA BIN SHAHARUZAMAN

LAB COORDINATOR

DR. MOHD RODY BIN MOHAMAD ZIN

RESEARCH COORDINATOR

MRS. NORMA HAYATI BINTI HASHIM

SENIOR ASSISTANT REGISTRAR
(ACADEMIC)

MRS. ZAIHASRAH BINTI ALIAS

SENIOR ASSISTANT REGISTRAR
(ADMINISTRATIVE AND FINANCIAL)

Figure 2.1 FKM Management

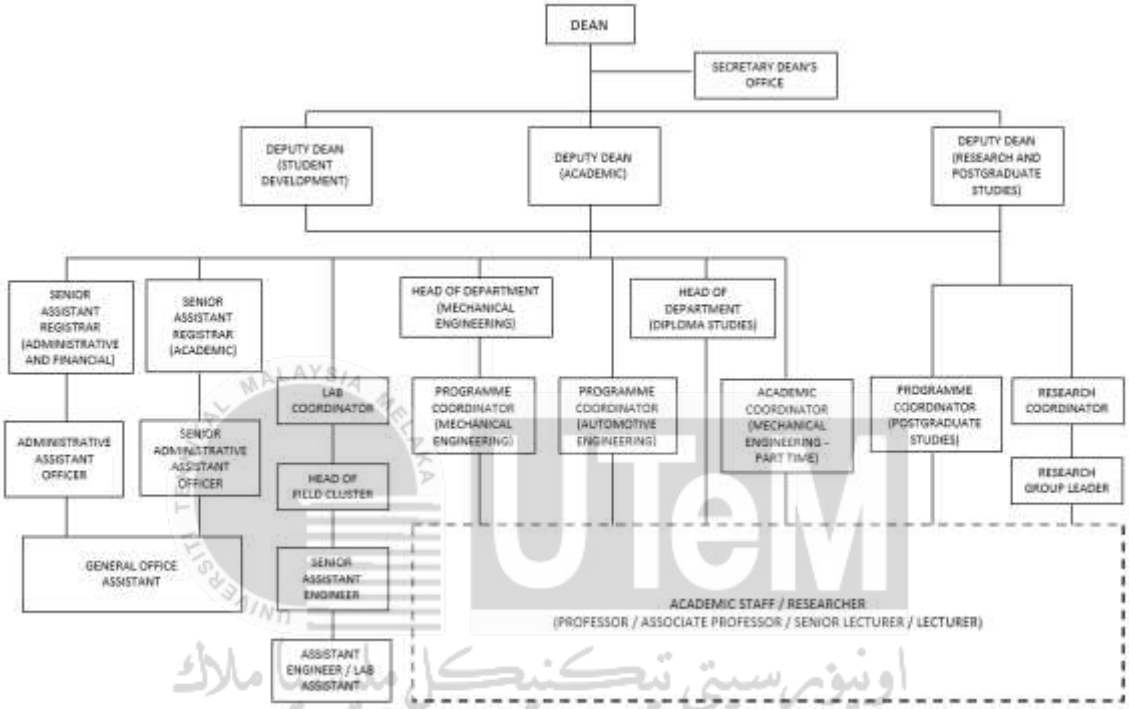

Figure 2.2 Organizational Structure of FKM

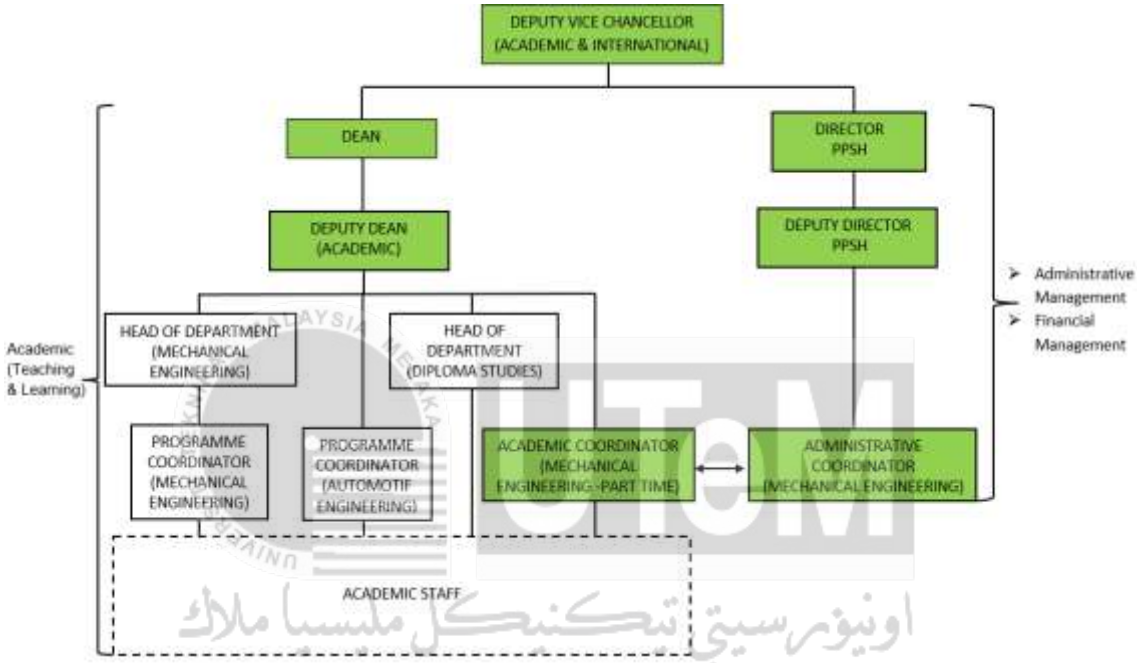

Figure 2.3 Management of Mechanical Engineering-Part Time Programme

IR DR. SUHAIMI BIN MISHA

ACADEMIC COORDINATOR
(PERAK GROUP 1-2)

DR. MD ISA BIN ALI

ACADEMIC COORDINATOR
(MELAKA GROUP 1-5)

DR. RAFIDAH BIN HASAN

ACADEMIC COORDINATOR
(MELAKA GROUP 6-7)

DR. WAN MOHD FARID BIN WAN MOHAMAD

ADMINISTRATIVE
COORDINATOR (PPSH)

Figure 2.4 Academic/Administrative Coordinator for BMCG Part Time Programme

3 ACADEMIC PROGRAMMES

3.1 Introduction

The Faculty of Mechanical Engineering offers academic programmes at both undergraduate and postgraduate levels. This handbook focuses on information pertaining to the Bachelor of Mechanical Engineering with Honours (BMCG) for part time mode. The normal study periods for BMCG part time programme is five and half years. However, students who obtained higher credit exemption may graduate earlier. The curriculum structures of the programmes are explained in Sections 3.6.

Starting from Semester 1 Session 2014/2015, the faculty offers only one bachelor degree programme (BMCG). The purpose of offering a single programme is to produce graduates with broad engineering skills and therefore, highly adaptable to the job market. The specialization of students into various mechanical engineering fields will be accomplished through the offering of elective courses in Final Year.

The BMCG part time was offered since Semester 2 Session 2017/2018. The intake of the programme is twice per years, every semester. The objective of the BMCG part time programme is to give oppurtunities to the employee to enhance their education and skill so that they can be promoted to the higher position. The class session was carried out during weekend.

The faculty's commitment in providing quality education programme continues by adhering to the guidelines set by the Engineering Accreditation Council of Malaysia (EAC). In addition, the faculty also continues the implementation of Outcome-Based Education (OBE) which has also been used by a large number of leading universities around the world. Using OBE system, the teaching and learning process is tailored to develop balanced graduates based on the objectives set in Programme Educational Objectives (PEO). Every taught course carries a set of learning outcomes (LOs), which students need to achieve upon completion of the course. These LOs are mapped to Programme Outcomes (POs) for assessment purposes.

3.2 Programme Educational Objectives (PEO) *for BMCG Part Time Programme*

PEOs are specific goals consistent with the mission and vision of the University, that are responsive to the expressed interest of programme stakeholders, describing the expected achievements of graduates in their career and professional life, few years after graduation.

The graduates from this programme are expected to become:

PEO1 Graduates who are competent and adaptable in multi industries by practicing the knowledge in mechanical engineering that is relevant to professional engineering practice. **(Competency)**

PEO2 Graduates who will pursue study in graduate works and others professional courses. **(Lifelong Learning)**

PEO3 Graduates who will be leader at note-worthy level and provide solutions that benefited the respective organization, society and nation. **(Leadership)**

3.3 Programme Outcomes (PO) *for BMCG Part Time Programme*

POs are statements that describe what students are expected to know and able to perform or attain by the time of graduation. These relate to the skills, knowledge, and behaviour that students acquire through the programme.

The graduates from this programme are expected to be able to:

PO1 Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex mechanical engineering problems. **(Engineering Knowledge)**

PO2 Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principle of mathematics, natural sciences and engineering sciences. **(Problem Analysis)**

PO3 Utilize a systematic approach to design solution for complex engineering problem that meet specified needs with appropriate consideration for public

health and safety, cultural, societal and environmental consideration. **(Design/Development of Solutions)**

PO4 Conduct investigations of complex problem using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. **(Investigation)**

PO5 Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. **(Modern Tool Usage)**

PO6 Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and consequent responsibilities relevant to professional engineering practice. **(The Engineer and Society)**

PO7 Understand and evaluate the sustainability and impact of professional engineering work in the solutions of complex engineering problems in societal and environmental context. **(Environment and Sustainability)**

PO8 Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. **(Ethics)**

PO9 Communicate effectively on complex engineering activities with engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions. **(Communication)**

PO10 Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings. **(Individual and Team Work)**

PO11 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. **(Life Long Learning)**

PO12 Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply them effectively as a member and leader in a team to manage projects and in multidisciplinary environments. **(Project Management and Finance)**

3.4 Career in Mechanical Engineering

Career as a mechanical engineer or assistant mechanical engineer (technical assistant) is highly remunerated, however it demands great responsibilities. Engineers and assistant engineers are problem solvers who provide solutions to any engineering problem that arises. In other words, they are knowledgeable people with the ability to solve problems. Hence, mechanical engineer must be of very skilled person and comfortable with his or her knowledge in mechanical engineering.

Mechanical engineering typically exists together with electrical and civil engineering in terms of its historical development. Due to highly ethical and challenging nature of the engineers and assistant engineers' job scope, it gained a professional and semi professional recognition. Therefore, it is the aim of every mechanical engineer to be recognised professionally in terms of their ability and competency. There are avenues where mechanical engineer can be registered as a Professional Engineer.

Engineers or assistant engineers must possess good ethical values. Virtues are universal, irrespective of his or her position, place of work or race. Engineer and assistant engineer must heed those virtues which include sincerity, transparency and consistency. Other qualities needed by engineers are computer-literate, good in interpersonal skills, creative and critical thinking skills.

Upon the completion of mechanical engineering programmes at Bachelor' Degree level, graduates have vast career opportunities. Mechanical Engineer and Assistant Mechanical Engineer are mostly employed in the manufacturing, automotive, marine, aerospace, oil & gas, robotic, mining and food and beverage (F&B) industries.

The job scope of a Mechanical Engineer among others are design, material selections and analysis of manufactured products. Some examples of the product include home appliances, health care and sport equipment, instrumentation and

crafts. Other fields of work include integration of mechanical, electronic engineering and computer control in the field of mechatronics.

Mechanical engineering graduates are employed in many industrial sectors which encompass the following work environments:-

a. Design and manufacturing of automotive components and engine
b. Defence industries, power generation and environmental protection
c. Marine industries and sea transport
d. Automation, control and robotic industries
e. Heavy machinery industries that use hydraulic and pneumatic system, electronic and digital driven machines
f. Agricultural and food production industries
g. Petrochemical, gas and mineral industries
h. Biotechnology and biomedical industries
i. Research and development, engineering management and service industries
j. Construction of building mechanical system

In the industry, graduates of mechanical engineering are highly marketable and hold a wide range of positions either in public agencies or private companies which include:

a. Mechanical Engineer
b. Sale & Service Engineer
c. Project Engineer
d. Technical Engineer
e. Production Engineer
f. Industrial Engineer
g. Plant Engineer
h. Design Engineer
i. Maintenance Engineer
j. Assistant Lecturer

k. Research Officer
l. Technical Officer

3.5 Bachelor of Mechanical Engineering with Honours (BMCG) Part Time

The curriculum structure for the first two years of Bachelor of Mechanical Engineering with Honours (BMCG) Part Time is to enhance the students' basic Mechanical Engineering knowledge before engaging in more advance programme courses. These courses include Engineering Mathematics, Engineering Materials, Engineering Graphics and CAD, Statics, Differential Equation, Computer Aided Design and Manufacturing, Electrical Systems, Principle of Measurements and Instrumentation, and Statistics. The practical work and workshops are designed to enhance students' knowledge and skills. In addition, students will also study courses such as Language Elective, English for Academic Purposes, Philosophy and Current Issues and Co-Curriculums.

In Year 3 and 4, students will undergo core curriculum programmes which cover advanced courses as well as compulsory university courses. Students are then required to undergo industrial training for at least 10 weeks, during the short semester (after year 4) in selected industries. The objectives are to strengthen the engineering knowledge and theory as well as their hands-on skills. It is expected that this training will provide our graduates with enough technical knowledge before advancing into a real career in industry.

In year 5 and 6 (final year), students shall carry out Final Year Project (FYP), programme core and elective courses which are focused on advanced knowledge of Mechanical Engineering. In addition, students will also sit a number of important courses such as Sustainability and Environment, Engineer & Society, Engineering Seminar and Entrepreneurship Technology. The courses are designed to provide students with soft skills such as engineering management, entrepreneurship, and moral development programme. The intended outcome is to produce mechanical engineering graduates with knowledge in their specialised field, as well as in non-

technical fields. The minimum number of credits required for an award of Bachelor of Mechanical Engineering with Honours is **135**. The breakdown of course credits in each semester may be referred in Chapter 3.6. However the actual courses offered every semester will depends on the student's credit exemption and minimum number of students register the courses.

3.6 Curriculum Structure for BMCG Programme

YEAR 1 (SEMESTER 1)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BLLW 1142	ENGLISH FOR ACADEMIC PURPOSES	W	2	-
BIPW 1132	PHILOSOPHY AND CURRENT ISSUES	W	2	-
BMFG 1313	ENGINEERING MATHEMATICS I	P	3	-
BMFG 1213	ENGINEERING MATERIALS	P	3	-
TOTAL			10	

YEAR 1 (SEMESTER 2)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BKKX XXX1	CO-CURRICULUM I*	W	1	-
BMCG 1013	DIFFERENTIAL EQUATIONS	P	3	-
BEKG 1233	PRINCIPLES OF MEASUREMENT AND INSTRUMENTATION	P	3	-
BMCG 1113	STATICS	P	3	-
TOTAL			10	

*Refer to Co-Curriculum Courses offered by Institute of Technology Management & Entrepreneurship (IPTK)

YEAR 1 (SPECIAL SEMESTER)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BMCG 1523	ENGINEERING GRAPHICS AND CAD	P	3	-
BMCG 2021	MECHANICAL ENGINEERING WORKSHOP	K	1	-
TOTAL			4	

YEAR 2 (SEMESTER 3)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BIPW 2132	APPRECIATION OF ETHICS AND CIVILIZATION	W	2	-
BEKG 1123	PRINCIPLES OF ELECTRIC AND ELECTRONICS	P	3	-
BMCG 1213	DYNAMICS	K	3	-
BMCG 2312	MANUFACTURING PROCESS	K	2	-
TOTAL			10	

YEAR 2 (SEMESTER 4)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BKKX XXX1	CO-CURRICULUM II*	W	1	-
BITG 1233	COMPUTER PROGRAMMING	P	3	-
BEKG 2433	ELECTRICAL SYSTEMS	P	3	-
BMCG 2513	COMPUTER AIDED DESIGN AND MANUFACTURING	K	3	-
TOTAL			10	

*Refer to Co-Curriculum Courses offered by Institute of Technology Management & Entrepreneurship (IPTK)

YEAR 2 (SPECIAL SEMESTER)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BLLW 2152	ACADEMIC WRITING	W	2	BLLW 1142
BMCG 1011	MECHANICAL ENGINEERING LABORATORY I	K	1	-
BLLW 1XX2	LANGUAGE ELECTIVE**	W	2	-
TOTAL			5	

**Refer to language courses offered by Centre for Language Learning (CeLL). Also refer to Other Elective Courses table.

YEAR 3 (SEMESTER 5)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BEKG 2443	ENGINEERING MATHEMATICS II	P	3	-
BMCG 2713	THERMODYNAMICS I	K	3	-
BMCG 2113	SOLID MECHANICS I	K	3	-
BMCG 2212	MICROPROCESSOR TECHNOLOGY	K	2	-
TOTAL			11	

YEAR 3 (SEMESTER 6)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BMCG 2613	FLUID MECHANICS I	K	3	-
BMCG 3333	MECHANICAL DESIGN	K	3	-
BMCG 3233	MECHANICAL VIBRATION	K	3	-
TOTAL			9	

YEAR 3 (SPECIAL SEMESTER)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BLLW 3162	ENGLISH FOR PROFESSIONAL INTERACTION	W	2	BLLW 2152
BMCG 2011	MECHANICAL ENGINEERING LABORATORY II	K	1	-
BXXX XXX2	GENERAL ELECTIVE*	W	2	-
TOTAL			5	

*Refer to Other Elective Courses table

YEAR 4 (SEMESTER 7)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BENG 2143	ENGINEERING STATISTICS	P	3	
BMCG 3713	THERMODYNAMICS II	K	3	BMCG 2713
BMCG 3613	FLUID MECHANICS II	K	3	BMCG 2613
TOTAL			9	

YEAR 4 (SEMESTER 8)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BMCG 3113	SOLID MECHANICS II	K	3	BMCG 2113
BMCG 3313	ENGINEERING DESIGN	K	3	-
BMCG 4113	FINITE ELEMENT ANALYSIS	K	3	-
BMCG 3011	MECHANICAL ENGINEERING LABORATORY III	K	1	-
TOTAL			10	

YEAR 4 (SPECIAL SEMESTER)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BMCU 3935	INDUSTRIAL TRAINING	P	5	-
TOTAL			5	

YEAR 5 (SEMESTER 9)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BMCU 3013	INTEGRATED DESIGN PROJECT	P	3	BMCG 3313
BMCG 4812	SUSTAINABILITY AND ENVIRONMENT	K	2	-
BMCG 3223	CONTROL ENGINEERING	K	3	-
BMCG 4743	HEAT TRANSFER	K	3	-
TOTAL			11	

YEAR 5 (SEMESTER 10)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BMCU 4972	FINAL YEAR PROJECT I	P	2	-
BMFG 4623	ENGINEERING MANAGEMENT AND ECONOMY	P	3	-
BMCG 4XX3	ELECTIVE I	E	3	-
BMCG 4XX3	ELECTIVE II	E	3	-
TOTAL			11	

YEAR 5 (SPECIAL SEMESTER)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BTMW 4012	ENTREPRENEURSHIP TECHNOLOGY	W	2	-
BMCU 4022	ENGINEER AND SOCIETY	P	2	-
BMCU 4011	ENGINEERING SEMINAR	P	1	-
TOTAL			5	

YEAR 6 (SEMESTER 11)

CODE	COURSE	CATEGORY	CREDIT	PRE-REQUISITE
BMCU 4984	FINAL YEAR PROJECT II	P	4	BMCU 4972
BMCG 4XX3	ELECTIVE III	E	3	-
BMCG 4XX3	ELECTIVE IV	E	3	-
TOTAL			10	
TOTAL OVERALL CREDIT			135	

NOTE:

CATEGORY	DESCRIPTION
W	UNIVERSITY COMPULSORY COURSE
P	COMMON CORE COURSE
K	PROGRAMME CORE COURSE
E	ELECTIVE COURSE

PROGRAMME ELECTIVE COURSES

FIELD	CODE	COURSE	CREDIT
THERMAL-FLUID	BMCG 4713	RENEWABLE ENERGY SYSTEM	3
	BMCG 4723	REFRIGERATION AND AIR CONDITIONING SYSTEM	3
	BMCG 4733	POWERPLANT SYSTEM	3
	BMCG 4613	COMPUTATIONAL FLUID DYNAMICS	3
	BMCG 4623	FLUID POWER AND TURBOMACHINERY	3
STRUCTURE AND MATERIALS	BMCG 4123	ADVANCED SOLID MECHANICS	3
	BMCG 4133	FRACTURE MECHANICS	3
	BMCG 4413	NON DESTRUCTIVE TESTING	3
	BMCG 4423	COMPOSITES AND ADVANCED MATERIALS	3
	BMCG 4433	METALLURGY	3
DESIGN AND INNOVATION	BMCG 4313	MECHANISM DESIGN	3
	BMCG 4323	RAPID PROTOTYPING TECHNOLOGY	3
	BMCG 4333	DESIGN QUALITY AND RELIABILITY	3
	BMCG 4343	DESIGN OPTIMIZATION	3
	BMCG 4513	ADVANCED COMPUTER AIDED DESIGN	3
MAINTENANCE	BMCG 4213	VIBRATION MONITORING OF ROTATING MACHINERY	3
	BMCG 4813	CONDITION BASED MAINTENANCE	3
	BMCG 4823	RELIABILITY, MAINTAINABILITY AND RISKS	3
	BMCG 4833	WEAR DEBRIS AND OIL ANALYSIS	3
	BMCG 4843	STRUCTURAL HEALTH MONITORING	3
AUTOMOTIVE	BMCG 4913	VEHICLE DYNAMICS	3

	BMCG 4923	AUTOMOTIVE TECHNOLOGY	3
	BMCG 4933	VEHICLE POWERTRAIN SYSTEMS	3
	BMCG 4943	INTERNAL COMBUSTION ENGINE	3
	BMCG 4953	VEHICLE SYSTEM MODELLING & SIMULATION	3

*Students are required to complete four (4) courses (total of 12 credits).

OTHER ELECTIVE COURSES

NUMBER	CODE	COURSE
LANGUAGE ELECTIVE		
1	BLLW 1222	MANDARIN LANGUAGE 1
2	BLLW 1242	KOREAN LANGUAGE 1
3	BLLW 1212	ARABIC LANGUAGE 1
4	BLLW 1252	GERMAN LANGUAGE 1
5	BLLW 1232	JAPANESE LANGUAGE 1
GENERAL ELECTIVE		
1	BIPW 3112	CRITICAL AND CREATIVE THINKING
2	BIPW 4122	NEGOTIATION SKILLS
3	BIPW 1152	INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY
4	BIPW 4112	ORGANIZATIONAL COMMUNICATION
5	BIPW 1142	PHILOSOPHY OF SCIENCE AND TECHNOLOGY
6	BIPW 2142	INDUSTRIAL SOCIOLOGY

4 SYLLABUS SYNOPSIS

Bachelor of Mechanical Engineering with Honours (BMCG) Part Time

YEAR 1 COURSES - UNIVERSITY COMPULSORY

BLLW 1142: ENGLISH FOR ACADEMIC PURPOSES

LEARNING OUTCOMES

By the end of the course, students should be able to:

LO1 Apply correct grammar rules according to context.

LO2 Demonstrate knowledge of various reading skills in the reading tasks given.

SYNOPSIS

This course aims to develop students' reading skills and grammar. A variety of academic reading texts and reading skills are explored to facilitate students' comprehension of the texts. These reading skills are also necessary in assisting students to master study skills. Grammar elements are taught in context to develop students' accuracy in the use of the language. This course also includes elements of blended learning.

REFERENCES

a. De Chazal, E., & Rogers, L. (2013). *Oxford EAP: A course in English for Academic Purposes*. Oxford: Oxford University Press.

b. McDonald, A. & Hancock, M. (2010). *English result*. Oxford: Oxford University Press.

c. Paterson, K. & Wedge, R. (2013). *Oxford grammar for EAP*. Oxford: Oxford University Press.

BIPW 1132: PHILOSOPHY AND CURRENT ISSUES (FALSAFAH DAN ISU SEMASA)

LEARNING OUTCOMES

In the end of this course, the students are able to:

LO1 Explain the current issues related to philosophy, National Education Philosophy and National Ideology.

LO2 Analyze the current issues based on main scholarly thought and various philosophical theories.

LO3 Examine the current issues according to philosophical comparative studies between dialogue and culture.

SYNOPSIS

This course will discuss on the concept of knowledge, ethics and civilization which emphasize on comparative available systems, social development and multi-cross cultural activities in Malaysia. Besides, this course is stressing on current and contemporary issues discussion related to economy, politic, social, culture and environment based on ethical and civilizational approach. This course will cover the comparative system, developmental phase, social development and cross cultural activities in order to produce a man with positive values.

REFERENCES

a. Dzulkifli A. R. dan Rosnani H. (Eds). (2019). *Pentafsiran Baharu Falsafah Pendidikan Kebangsaan dan Pelaksanaannya Pasca 2020*. Kuala Lumpur: IIUM.
b. Osman Bakar (2019). *Classification of Knowledge in Islam: A Study in Islamic Schools of Epistemology*. Kuala Lumpur: IBT.
c. Osman Bakar (2016). *Qur'anic Pictures of the Universe: The Scriptural Foundation of Islamic Cosmology*. Kuala Lumpur: UBD dan IBT.
d. Osman Bakar (2008). *Tawhid and Science: Islamic Perspectives on Religion and Science, (2nd Ed.)*. Shah Alam: Arah Publications.
e. Shaharir Mohamad Zain (2012), *Berakhir Sudahkah Ilmu Dalam Acuan Sendiri?*, Pusat Dialog Peradaban UM.
f. Shaharir Mohamad Zain (2018), *Falsafah Ilmu Daripada Karya-Karya Besar Sains dan Matematik Islam Malayonesia*, Akademi Kajian Ketamadunan.
g. Tajul Ariffin Noordin. (1993). *Perspektif Falsafah dan Pendidikan di Malaysia*. Kuala Lumpur: DBP
h. Maszlee Malik.(Dr). (2017). *Foundation of Islamic Governance: A Southeast Asian Perspective* (1st Ed). London & New York : A Routledge

BKKX XXX1: CO-CURRICULUM I

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Recognise a balanced and comprehensive education.
LO2 Develop leadership aspects stressing on diciplines and cooperation within a group or organisaton.
LO3 Build personality and character guided by rules of conduct.
LO4 Foster cooperation and unity in multi-racial society.

SYNOPSIS

a. Cultural

Choir, *Gamelan, Cak Lempung, Nasyid, Seni Khat*, Seni Lakon, Art, English Elocution, Bahasa Melayu Elocution, and *Kompang*.

b. Entrepreneurship
Video, Film and Photography, Publishing & Journalism, Computer and Technopreneurship.

c. Society
Fiqh Muamalat*, Fiqh Amali, Tahsin Al-Quran & Yaasin* and Peer Program.

d. Recreation
Go-Kart, Adventure and Cycling.

e. Sports
Swimming, Volley Ball, Golf, *Takraw*, Aerobic, Badminton, Football and Net ball.

f. Martial Arts
Silat Gayong, Karate-Do and Taekwando.

YEAR 1 COURSES - COMMON CORE

BMFG 1313: ENGINEERING MATHEMATICS I

LEARNING OUTCOMES

Upon completion of this subject, students should be able to:

LO1 Identify the domain and range of multivariable functions.

LO2 Solve double and triple integrals using various techniques.

LO3 Apply integration techniques to solve for mass, moments and lamina.

LO4 Perform the given tasks that pertain to the engineering problems by using the knowledge of engineering mathematics.

SYNOPSIS

This course is a blend of analytical and numerical approaches that mainly focusing on the matrices, nonlinear equations, eigenvalues and eigen vectors, complex numbers, interpolation, differentiation, integration and vector valued functions.

REFERENCES

a. James, G., 2015, Modern Engineering Mathematics, 5th edition, Pearson.

b. Khoo, C.F., Sharifah Sakinah, S. A., Zuraini, O.and Lok, Y.Y., 2009, Numerical Methods, 3rd Edition, Pearson Prentice Hall.

c. Muzalna M.J, Irma Wani J., Rahifa R. and Norazlina A.R., 2009, Engineering Mathematics, 2nd Edition, Prentice Hall.

d. Kreysziq E., 2009, Advanced Engineering Mathematics, 9th edition, John Wiley.
e. Guo W., 2015, Advanced Mathematics for Engineering and Applied Sciences, Pearson.

BMFG 1213: ENGINEERING MATERIALS

LEARNING OUTCOMES

Upon completion of this course, students should be able to:

LO1 Explain the basic concepts of engineering materials in terms of interatomic bonding and crystal structure.
LO2 Analyze the properties of engineering materials based on its structure.
LO3 Apply the basic understanding of engineering materials properties to determine their processing method.

SYNOPSIS

This course introduces basic concepts of engineering materials that covers introduction to engineering materials, interatomic bonding, crystalline structure and imperfections and diffusion in solid. Explanation on different types of engineering material (i.e. metal, ceramic, polymer and composites), its mechanical properties, basic applications and processing are also included. Introduction to the binary phase diagrams (composition and microstructure correlation) is also given.

REFERENCES

a. Callister, W.D. Jr., 2010, *Materials Science and Engineering - An Introduction*, 8th Edition. John Wiley & Sons Inc.
b. Smith, W.F., 1998, *Principle of Materials Science & Engineering*, 4th Edition, Mc. Graw Hill.
c. Shackelford, J.F., 2000, *Materials Science and Engineering - An Introduction*, 5th Edition, Prentice Hall.
d. Bolton, W., 2001, *Engineering Materials Technology*, 3rd Edition, BH Publisher.
e. Vernon, J. (2001) *Introduction to Engineering Materials*, 4th Edition, Palgrave MacMilan.

BMCG 1013: DIFFERENTIAL EQUATIONS

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Describe the basic concept and solution of second order differential equations, Laplace transform and Fourier series.

LO2 Select an appropriate technique to solve problems involving differential equations.

LO3 Apply the concept of differential equations in solving engineering problems.

SYNOPSIS

This course is intended to introduce the concept and theories of differential equations. Second order linear differential equations with constant coefficients will be solved by using the methods of undetermined coefficient, variation of parameters and Laplace transform. Fourier series in relation to periodic functions will be discussed. An introduction to the solution and application of partial differential equations with boundary value problems using the method of separation of variables and Fourier series will also be discussed.

REFERENCES

a. Muzalna, M. J., Irmawani, J., Rahifa, R., Nurilyana, A. A., 2010, *Module 2: Differential Equations*, Penerbit UTeM.

b. Cengel, Y. A., & Palm, W. J., 2013, *Differential Equations for Engineers and Scientists*, 1st Ed. McGraw-Hill., U.S.A.

c. Nagle, R. K., Saff, E. B., & Snider, A. D., 2011, *Fundamentals of Differential Equations and Boundary Value Problems*, 6 th Ed. Pearson Education Inc., U.S.A.

d. Kohler, W., & Johnson, L., 2011. *Elementary Differential Equations with Boundary Value Problems*. Pearson Education Inc., U.S.A.

e. Edwards, C. H., & Penny, D. E., 2008. *Differential Equations and Boundary Value Problems*, 4 th Ed. Pearson Education Inc., New Jersey, U.S.A.

BEKG 1233: PRINCIPLES OF MEASUREMENT AND INSTRUMENTATION

LEARNING OUTCOMES

Upon completion of this course, students should be able to:

LO1 Describe the principle, various terms and standards in measurement.

LO2 Explain the principles of measurement devices.

LO3 Apply the suitable bridge techniques to measure component values such as resistance, inductance and capacitance.

LO4 Explain the operation, function and applications of transducers/sensors.

SYNOPSIS

This course discusses about units and dimensions, standards, errors, static

characteristic, noise and calibration in measurement devices such as galvanometers, ammeters, voltmeters, wattmeter, temperature, force and torque and pressure measurement as well as accelerometer. It also introduces oscilloscope and sensors for instrumentation application.

REFERENCES

a. Kalsi, H.S., 2010, *Electronic Instrumentation*, 3rd Ed., Tata McGraw Hill.
b. Bakshi, U.A., Bakshi, A.V., and Bakshi, K.A., 2009, *Electronic Measurements and Instrumentation*, Technical Publications Pune.
c. Wolf. S., Smith, R.F.M., 2004, *Reference Manual for Electronic Instrumentation Laboratories*, 2nd Ed., Prentice-Hall.
d. Vaisala, V.O., 2006, *Calibration Book*

BMCG 1113: STATICS

LEARNING OUTCOMES

On successful completion of this course, student should be able to:

LO1 Describe and apply the basic concepts and fundamental principles of engineering mechanics (statics).

LO2 Analyze and solve equilibrium problems of particle.

LO3 Analyze and solve equilibrium problems of rigid body.

SYNOPSIS

The engineering mechanics of statics provides an introduction and the basic concept of statics as physical sciences, system of units, scalars and vectors, Free Body Diagram, forces system, force system resultants and moment, equilibrium of a particle, equilibrium of a rigid body, structural analysis (trusses analysis and simple frames and machines), friction and center of gravity and centroid.

REFERENCES

a. Hibbeler, R.C., 2013, *Engineering Mechanics –Statics*, 13th Ed., Prentice Hall.
b. Beer, F.P., and Johnston, E.R., 2011, *Statics and mechanics of materials*, McGraw-Hill.
c. Morrow, H.W., 2011, *Statics and Strength of Materials*, Prentice Hall.
d. Mott, R.L., 2010, *Statics and strength of materials*, Prentice Hall.

BMCG 1523: ENGINEERING GRAPHICS AND CAD

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Explain the engineering graphics fundamentals.

LO2 Construct technical drawing using manual sketching and computer aided design.

LO3 Communicate by using engineering drawings.

SYNOPSIS

The course will provide students with an understanding of the importance of engineering graphics as a communication tool among engineers. Student will be exposed to the engineering graphics fundamentals of manual sketching, geometric dimensioning and tolerancing, graphic projections, sectioning and engineering drawings. Students will develop visualization skills by constructing technical drawings using manual sketches and computer aided design (CAD) software. The course consists of both lecture and practical session where students will be guided in presenting and interpreting engineering drawings correctly.

REFERENCES

a. Rizal, M. A. et al., 2009, *Modul Lukisan Berbantu Komputer*, Penerbit Universiti Teknikal Malaysia Melaka, Melaka.
b. Dix, M. & Riley, P., 2014, *Discovering AutoCAD 2014*, Prentice Hall, New York.
c. Giesecke, F. E., Mitchell, A., Spencer, H. C., Hill, I. L., Dygdon, J. T. and Novak, J. E., 2011, *Technical Drawing*, 14th Ed., Prentice Hall, New York.
d. Jensen, C., & Jay D. H., 2007, *Engineering Drawing and Design*, 7th Ed., Glencoe and McGraw Hill, New York.
e. Frederick, E. G. & Mitchell, A., 2008, *Technical Drawing and Engineering Drawing*, 14th Ed., Prentice Hall.

YEAR 1 COURSES - PROGRAMME CORE

BMCG 2021: MECHANICAL ENGINEERING WORKSHOP

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Identify common shop hazards and use common shop safety equipments.

LO2 Use various kinds of hand tools, measuring tools and equipments for workshop practice.

LO3 Work as an effective member of a team to produce engineering products.

SYNOPSIS

This course covers the fundamentals of cutting, forming, joining and machining processes. The processes include sheet metal forming, welding, conventional milling and CNC Lathe. Other aspects such as handling, safety regulations, and main functions of the machining are introduced. The students will be exposed with practical use of the machine.

REFERENCES

a. Kalpakjian, S. & Schmid, S.R., 2013, *Manufacturing Engineering and Technology*, 7th Ed., Pearson.
b. Groover, M.P., 2007, *Fundamentals of Modern Manufacturing*, 5th Ed., John Wiley & Son Inc.
c. Mike, T., 2000, *Basic Manufacturing*, Butterworth-Heinemann.

YEAR 2 COURSES - UNIVERSITY COMPULSORY

BIPW 2132: APPRECIATION OF ETHICS AND CIVILIZATION (PENGHAYATAN ETIKA DAN PERADABAN)

LEARNING OUTCOMES

Pada akhir kursus ini, pelajar akan dapat:

LO1 Menjelaskan konsep etika daripada perspektif peradaban yang berbeza.

LO2 Membandingkan sistem, tahap perkembangan, kemajuan sosial dan kebudayaan merentas bangsa.

LO3 Membincangkan isu kontemporari berkaitan ekonomi, politik, sosial, budaya dan alam sekitar daripada perspektif etika dan peradaban

SYNOPSIS

Kursus ini menerangkan tentang konsep etika daripada perspektif peradaban yang berbeza. Ia bertujuan bagi mengenal pasti sistem, tahap perkembangan, kemajuan dan kebudayaan sesuatu bangsa dalam mengukuhkan kesepaduan sosial. Selain itu, perbincangan berkaitan isu-isu kontemporari dalam aspek ekonomi, politik, sosial, budaya dan alam sekitar daripada perspektif etika dan peradaban dapat melahirkan pelajar yang bermoral dan profesional. Penerapan amalan pendidikan berimpak tinggi (HIEPs) yang bersesuaian digunakan dalam penyampaian kursus ini. Di hujung kursus ini pelajar akan dapat

menghubungkaitkan etika dan kewarganegaraan berminda sivik.

REFERENCES

a. Shamsul Amri Baharuddin (2012). Ethnic Relations Module. Selangor: Institute of Ethnic Studies Universiti Kebangsaan Malaysia.
b. Harari Y. N. (2017). Homo Deus : A Brief History of Tomorrow. Australia: Harper Collins.
c. MacKinnon, B. (2015). Ethics: Theory and Contemporary Issues (8th) ed). Stamford CT: Cengage Learning.

BKKX XXXI: CO-CURRICULUM II

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Recognise a balanced and comprehensive education
LO2 Develop leadership aspects stressing on diciplines and cooperation within a group or organisaton.
LO3 Build personality and character guided by rules of conduct.
LO4 Foster cooperation and unity in multi-racial society.

SYNOPSIS

a. Cultural
   Choir, Gamelan, Cak Lempung, Nasyid, Seni Khat, Seni Lakon, Art, English Elocution, Bahasa Melayu Elocution, and Kompang.
b. Entrepreneurship
   Video, Film and Photography, Publishing & Journalism, Computer and Technopreneurship.
c. Society
   Fiqh Muamalat, Fiqh Amali, Tahsin Al-Quran & Yaasin and Peer Program.
d. Recreation
   Go-Kart, Adventure and Cycling.
e. Sports
   Swimming, Volley Ball, Golf, Takraw, Aerobic, Badminton, Football and Net ball.
f. Martial Arts
   Silat Gayong, Karate-Do and Taekwando.

BLLW 2152: ACADEMIC WRITING

LEARNING OUTCOMES

By the end of the course, students should be able to:

LO1 Prepare clear and detailed descriptions of a product related to fields of interest.
LO2 Express arguments systematically in a composition.
LO3 Prepare short reviews of technical materials.

SYNOPSIS

This course aims to equip the students with the skills to communicate clear and detailed viewpoints in writing. The students are expected to have a stand

on topics of their fields by providing advantages and disadvantages to support their arguments. From time to time, consultations with the students will be conducted throughout the completion of their assignments. This serves as the formative evaluation in the course. Grammar components are embedded in the course to support the required writing skills. Blended learning is incorporated in this course.

REFERENCES

a. De Chazal, E., & Rogers, L., 2012, Oxford EAP: *A Course In English For Academic Purposes*. Oxford: Oxford University Press.
b. Hancock, M. & McDonald, A., 2010, *English Result Upper-Intermediate*. New York: Oxford University Press.
c. Paterson, K. & Wedge, R., 2013, *Oxford Grammar for EAP*. UK: Oxford University Press.

BLLW 1XX2 LANGUAGE ELECTIVE

Refer to Language Elective Courses

YEAR 2 COURSES - COMMON CORE

BEKG 1123: PRINCIPLES OF ELECTRIC AND ELECTRONICS

LEARNING OUTCOMES

Upon completion of this course, students should be able to:

LO1 Explain the basic principles of electrical and electronics components, terminologies, configuration, laws and rules.
LO2 Apply appropriate circuit analysis methods to solve DC (resistive) circuits problems.
LO3 Analyze circuits containing semiconductor devices.

SYNOPSIS

This course will discuss about the basic principles of electrical and electronics; Introduction to electric element, symbol and components. KCL, KVL, Node and Mesh in solving DC series and parallel circuit. Introduction in magnetism, electromagnetism and AC characteristic. Introduction to semiconductors, atomic structures, energy band, P-type and N-type. Study on structure, principle and application of diode, BJT and Op-Amp circuits.

REFERENCES

a. Floyd, T.L., 2010, *Principles of Electric Circuits*, Pearson, 9th Ed.

b. Floyd, T.L., and Buchala, D.M., 2010, *Electric Circuits Fundamentals*, Pearson, 8th Ed.
c. Boylestad, R.L., Nasheslsky, L., 2010, *Electronic Devices and Circuit Theory*, Pearson Prentice Hall.

BITG 1233: COMPUTER PROGRAMMING

LEARNING OUTCOMES

Upon completion of this course, students should be able to:

LO1 Describe the fundamental principles of problem solving, programming techniques and structures in program development.
LO2 Explain problems and their solutions based on the principles of problem solving and programming techniques.
LO3 Trace and debug in troubleshooting program applications.
LO4 Construct computer program codes by applying suitable programming structures and techniques.

SYNOPSIS

This course covers the introductory topics in programming using C++ language. It includes the introduction to computers and programming, the fundamentals of programming, problem solving and software development. Data types and operators, selection, repetition, function, array, file, structured data and pointer are among the topics covered in the course.

REFERENCES

a. Gaddis, T., 2011, *Starting Out with C++ Brief Version: From Control Structures Through Objects, 7*th. Edition, Pearson Education.
b. Abdullah, N. et. al, 2006, *Lab Module Computer Programming BITG 1113*, FTMK, UTeM
c. Friedman, Koffman, 2010, *Problem Solving, Abstraction and Design using C++*, Pearson Education.
d. Etter, D.M., Ingber, J.A., 2008, *Engineering Problem Solving with C++*, 2nd Edition, Pearson Education.
e. Hanly, J.R, 2002, *Essential C++ for Engineers and Scientists*, Addison Wesley.

BEKG 2433: ELECTRICAL SYSTEM

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Explain the major components of electrical power system: generation, transmission, and distribution system.
LO2 Calculate the AC voltage and current characteristic in AC circuits.

LO3 Analyze the single and three phase circuits by emphizing on complex power and power factor correction.

LO4 Analyze the magnetic, single phase transformer and three phase transformer equivalent circuits.

SYNOPSIS

This is an introductory course for students on the fundamental knowledge of electrical power system. The students will be taught on the physics of electrical power system, which includes the theory and analysis of electromagnetism, followed bypower concepts &equations (single and three phase), power factor &power factor corrections, single and three-phase system and per-unit calculation. There will also topics on characteristics for static and rotating electric machine principles, including AC, DC, synchronous, induction motor and transformer. Furthermore, students will be introduced to the concepts on the electric power system network (generation, transmission and distribution) and various power generation system and energy sources.The students will also learn on basic characteristics and performance of electrical transmission line and distribution system.

REFERENCES

a. Glover, S. & Overbye, 2012, *Power System Analysis and Design*, 5th ed., Cengage Learning.

b. Saadat, H., 2004, *Power System Analysis*, 2nd ed., Mc-Graw Hill.

c. Hughes, *Electrical and Electronic Technology*, 10th ed., UK: Pearson Edu. Ltd.

YEAR 2 COURSES - PROGRAMME CORE

BMCG 1213: DYNAMICS

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Describe the fundamentals of dynamics.

LO2 Apply the dynamics of particles and rigid bodies using principle of force and acceleration, work and energy, and impulse and momentum.

LO3 Analyze the dynamics of particles and rigid bodies by using the principle of dynamics.

SYNOPSIS

This course introduces the principle of

kinematics and kinetics of particles and rigid bodies. The lessons cover the concept of position, velocity and acceleration of particles; and application of Newton's second law, Principle of Work and Energy, Principle of Impulse and Momentum for both particles and rigid bodies.

REFERENCES

a. Hibbeler, R. C., 2012, *Engineering Mechanics, Dynamics*, 13th Edition, Prentice Hall.
b. Beer, F. P., Johnston, E. R. and Flori, R., 2008, *Mechanics for Engineers, Dynamics*, 5th Edition, McGraw-Hill.
c. Beer, F. P., Johnston, E. R., Clausen, W. E., Eisenberg, E. R. and Cornwell, P. J., , 2010, *Vector Mechanics for Engineers: Dynamics*, 9th Edition, McGraw Hill.

BMCG 2312: MANUFACTURING PROCESS

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Explain the processes and aspects involved in manufacturing and manufacturing related activities.

LO2 Discuss the manufacturing and manufacturing related activities issues on sustainability of resources and environment.

LO3 Engage in the in life long learning in the context of manufacturing technology changes.

SYNOPSIS

This course covers theoretical issues of manufacturing and the quality aspects of manufacturing such as quality assurance and tolerance. The type and fundamental principle of joining processes, metal casting processes, forming processes, shaping processes, material removal processes, modern machining processes and their equipments are also covered. The quantitative problem analysis of certain manufacturing processes is included as well. Societal and environment issue in manufacturing processes are also included. Finally the need to engage in life-long learning processes is emphasised as to ensure students alert on the manufacturing technological changes.

REFERENCES

a. Groover, M.P., 2007, *Fundamentals of Modern Manufacturing*, 3rd Edition, John Wiley & Sons Inc.
b. Kalpakjian, S., and Schmid, S. R., 2001, *Manufacturing Engineering and Technology*, 5th Edition,Prentice Hall International.

c. Schey, J.A., 1999, *Introduction to Manufacturing Processes,* McGraw Hill.

BMCG 2513: COMPUTER AIDED DESIGN AND MANUFACTURING

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Acquire and apply fundamental sketching and feature modeling, build feature based models of parts and assemblies for easy editing.

LO2 Produce document design intent of parts and assemblies in manufacturing drawings.

LO3 Design and develop products effectively through the applications of engineering design methodology.

SYNOPSIS

This course will empower the students with fundamental knowledge and technical skills of 3D solid modeling skills using industry-proven 3D mechanical CAD/CAM software. The students will learn about theory of CAD/CAM systems, the different techniques for creating sketches, solid models, assemblies and CAM operations with emphasis on design intent. The course includes hands-on exercises and best practice methods for students to interpret common error messages during part, assembly, drafting stages and machining stages.

REFERENCES

a. Dassault Systeme, 2012, *Solidworks 2012 Essential Part Assembly and Drawing*, France.

b. Dassault Systeme, 2006, *CATIA R16: Part Design Fundamental* and CATIA machining, France.

c. Rao, P.N., 2004, *CAD/CAM Principles and Applications*, 2nd Edition, McGraw Hill

BMCG 1011: MECHANICAL ENGINEERING LABORATORY I

LEARNING OUTCOMES

At the end of the session, students should be able to:

LO1 Observe discipline in attending laboratory sessions, applied safety precautions before, during and after conducting experiments in terms of experimental procedures and aware of the general experimental ethics.

LO2 Use basic mechanical engineering instruments to measure engineering variables pertinent to the conducted experiments

LO3 Write a well organised, sensible and readable technical reports

which describe the experiment in a standard writing format

SYNOPSIS

Introduction to Science, Engineering and Technology. Introduction to safety. Ethics in laboratory. Use of scientific method. Mechanical measurement concept. Introduction to measuring devices. Basic engineering instruments. Use of instrument to measure engineering variables. Experimental report writing.

The experiments will be conducted in mechanical engineering laboratories that study fundamental engineering concepts in statics, dynamics, material sciences, measurements and instrumentation as well as engineering drawing.

REFERENCES

a. Wheeler, A.J. and Ganji, A.R., 2010. Introduction to Engineering Experimentation, 3rd Edition, International Edition, Pearson.
b. Alan, S.M., 2001. Measurement and Instrumentation Principles, 1st Edition, Butterworth-Heinemann
c. Holman, J.P. 2001. Experimental Methods for Engineers. 7th Ed., McGraw Hill.

YEAR 3 COURSES - UNIVERSITY COMPULSORY

BLLW 3162: ENGLISH FOR PROFESSIONAL INTERACTION

LEARNING OUTCOMES

By the end of the course, students should be able to:

LO1 Apply the concepts of data description, normal and sampling distributions, estimation and hypothesis testing, ANOVA, regression and non-parametric tests to solve mathematical problems.

LO2 Analyze engineering data using descriptive statistics.

LO3 Deduce statistical inference for engineering problems by using the techniques of estimation, hypothesis testing and regression.

SYNOPSIS

This course which is designed based on a blended and student-centred learning approach aims to develop students' listening skills as well as communication skills and strategies. Among the elements covered are professional interactions that include group discussion and public speaking. Students are also required to express ideas with relevant examples in public speaking and online assessments.

They are also exposed to the rudiments of
grammar implicitly via the communicative activities.

REFERENCES

a. Fry, R., 2016, *101 Smart Questions To Ask On Your Interview*. U.K.: New Page Books.
b. Cooper, S., 2016, *100 Tricks To Appear Smart In Meetings: How To Get By Without Even Trying*. Andrews McMeel Publishing.
c. Hood, J.H., 2013, *How To Book Of Meetings: A Complete Guide For Every Business*. South Australia: Magill.
d. Carmine,G., 2014, *Talk like TED: The 9 Public-Speaking Secret Of The World's Top Minds*. New York: St Martins Press.
e. Jason, S.W., 2013, *Workplace Communication For The 21st Century: Tools And Strategies That Impact The Bottom Line*. California: Praeger.

BIPW XXX2 GENERAL ELECTIVE

Refer to General Elective Courses

YEAR 3 COURSES – COMMON CORE

BEKG 2443: ENGINEERING MATHEMATICS II

LEARNING OUTCOMES

Upon completion of this subject, students should be able to:

LO1 Describe the fundamental concepts of multivariable functions, multiple integrals and vector calculus.

LO2 Solve the mathematical problems that involve function of several variable, multiple integrals and vector calculus.

LO3 Apply the knowledge of advanced engineering mathematics to deal with the engineering problems.

SYNOPSIS

This course consists of three chapters: Function of Several Variables: Functions of Two or More Variables, Limit and Continuity, Partial Derivatives, Total Differential, Chain Rule, Implicit Differentiation and Local Extrema.

Multiple Integrals: Double Integral, Double Integral Over Non-rectangular Regions,

Double Integral in Polar Coordinates, Triple Integral, Triple Integral in Cylindrical and Spherical Coordinates and Moment and Centre of Gravity.
Vector Calculus: Vector fields, Line integral, Green's theorem, Curl and Divergence, Parametric surfaces and their Areas, Surface integrals, Stoke's theorem and Divergence theorem.

REFERENCES

a. Yusof, Y. M., Baharun, S. And Rahman, R. A., 2013. Multivariable calculus for Independent learners. Pearson, Malaysia.
b. Croft, A., Davison, R., Hargreaves, M. and Flint, J., 2012. Engineering Mathematics. Pearson Higher Ed, USA.
c. Anton, H., Bivens, I., and Davis, S., 2010. Calculus Multivariable, 8th edition. John Wiley & Sons, USA.
d. Stewart, J., 2015. Calculus. Cengage Learning, USA.
e. Colley S. J., 2012. Vector Calculus 4th Edition. Pearson, Boston.

YEAR 3 COURSES - PROGRAMME CORE

BMCG 2713: THERMODYNAMICS I

LEARNING OUTCOMES

At the end of this course, student should be able to:

LO1 Define the First and Second Law of Thermodynamics.
LO2 Apply the thermodynamic principles using property tables.
LO3 Solve the thermodynamics processes relating to ideal gas and pure substances.

SYNOPSIS

The aim of this course is to provide students a basic understanding of the thermodynamics fundamental laws and the ability to implement them in solving a range of simple engineering problems. The course covers the following topics:

- Introduction to thermodynamics: relevance in the context of energy and the environment.
- Basic concepts: microscopic and macroscopic points of view, system and control volume approaches, properties, state, equilibrium, processes and cycles.
- Energy, heat, work and the First Law: kinetic, potential and internal energy;

heat transfer; displacement work and shaft work; the first law of thermodynamics for a system.

- Properties of substances: pure substances; the two-property rule, state diagrams; intensive and extensive properties; internal energy, enthalpy and specific heats; ideal and perfect gases; phase change, vapour and liquid properties, steam and water.
- The First Law for flow processes: the steady-flow energy equation and application to e.g. throttling processes, nozzles, turbines, pumps, compressors.
- Consequences of the Second law: Clausius inequality, definition of entropy, state diagrams using entropy; T dS relationships; isentropic processes for perfect gases; isentropic efficiency; simple ideas of work potential in the presence of the environment.

REFERENCES

a. Cengel, Y.A., & Boles, M.A., 2014, *Thermodynamics: An Engineering Approach*, 8th Edition, McGraw-Hill, Singapore.
b. Moran, M.J., Shapiro, H.N., Boettner, D.D. & Bailey, M.B., 2014, *Fundamental of Engineering Thermodynamics*, 8th Edition, John Wiley & Sons, Inc.
c. Borgnakke, C. & Sonntag, R. E., 2012, *Fundamentals of Thermodynamics*, 8th Edition, John Wiley & Sons, Inc.

BMCG 2113: SOLID MECHANICS I

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Describe and apply the basic concepts and fundamental principles of solid mechanics.
LO2 Analyse and solve the state of stress and strain in elastic structural members under various loading conditions.
LO3 Analyze and determine the principle stresses for plane stress problem due to combine loading.

SYNOPSIS

Introduction to various types of structures and type of supports. Concepts of stress, strain, shear force and bending moment. Theory on torsion. Pure bending on a structure. Combination of loads. Transformation of stress.

REFERENCES

a. Beer, F.P., Johnston E.R., Jr, John, T., Dewolf, Kazurek, D. F., 2012, *Mechanics of Materials*, 6th Edition (Global Edition) , McGraw-Hill.

b. Hibbeler, R.C., 2011, *Mechanics of Materials*, 8th Edition in SI Unit, Prentice Hall.
c. Gere, J.M., 2004, *Mechanics of Materials*, Thomson.
d. Vable, M., 2002, *Mechanics of Materials*, Oxford University Press.
e. Shames, I.H., 2000, *Introduction to Solid Mechanics*, Prentice Hall.

BMCG 2212: MICROPROCESSOR TECHNOLOGY

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Explain the architectures of microprocessor technology and its components.
LO2 Characterize functions of microprocessor and the peripheral devices.
LO3 Design applications for the simple problems in the field of control of processes and machines using microprocessor technology.

SYNOPSIS

Introduction and examples of practical utilizations in the field of control systems, data acquisition and communication using microprocessor technology. Explanation of basic terms (memory, bit, byte, word, address, bus, microprocessor, microcomputer, register, instruction, instruction set, program, stack, arithmetical/logical unit) and basic principles of the program execution (interrupt and timer/counter). Combinational and sequential logic gate. Computer number system. Principles of the function and utilization of the input/output ports as general digital inputs and output for switches, sensors, LED indicators, alphanumeric LCD, DC and stepper motors. Utilization of A/D converter and serial communication interface for real application.

REFERENCES

a. Godse, A.P. and Godse, D.A., A Comprehensive Aproach To Microcontrollers, Technical Publications, 2012.
b. Godse, A.P. and Godse, D.A., Microcontroller, Technical Publications, 2013.
c. Mazidi, M.A., PIC Microcontroller and Embedded Systems using assembly and C for PIC18, 2nd Edition, Pearson (Prentice Hall), 2016.
d. Martin, P.B., PIC Microcontrollers, 3rd Edition, Newnes, 2013.
e. Martin, P.B., Interfacing Pic Microcontrollers, 2nd Edition, Newnes, 2013.

BMCG 2613: FLUID MECHANICS I

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Define and describe the basic concepts and fundamental principles of fluid mechanics.

LO2 Apply fluid mechanics equations in solving fluid mechanics problem.

LO3 Analyse the fluid mechanics concepts in solving fluid mechanics problem.

SYNOPSIS

The introduction to the basic physical properties of fluids. Definition of pressure and head. Derivation of hydrostatic equation and its application in pressure measurement, static forces analysis on immersed surface and buoyancy analysis. The introduction to fluid dynamics and fluid flow analysis. Derivation of flow equations. The application of energy equation and Bernoulli equation in the calculation of flow velocity, discharge, and head lost in piping systems. Dimensional analysis and its application.

REFERENCES

a. Cengel, Y. A. and Cimbala, J. M., 2009, *Fluid Mechanics: Fundamentals and Applications*, 2nd International Ed., McGraw-Hill, Singapore.

b. Munson, B.R., Young D.F. and Okiishi, T.H., 2009, *Fundamentals of Fluid Mechanics*, 6th Ed., John Wiley & Sons, Inc, Asia.

c. Douglas, J. F., Gasiorek J. M. and Swaffield, J. A., 2006, *Fluid Mechanics*, 5th Ed., Prentice Hall, Spain.

BMCG 3333: MECHANICAL DESIGN

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Apply the formulation for optimized and safe design based on engineering standard.

LO2 Analyze the statics and dynamics of mechanical systems design

LO3 Evaluate mechanical design system in solving complex engineering problem.

SYNOPSIS

This course covers a brief review of the Engineering Design Process, Design for Static Strength, Design for Fatigue Strength, Linkage Mechanisms and the Applications of Springs and Brakes, Design of Threaded and Welded Joints, Bearings and Shafts Design and Balancing, the Basics of Gyroscopes, Gear Strength for Power Transmission,as well as the Belt and Chain for Flexible Power Transmission.

REFERENCES

a. J. K. Nisbett & R. G. Budinas, 2014, Shigley's Mechanical Engineering Design, Ninth Edition in SI Units, McGraw-Hill Companies, Inc., New York.
b. Peter R. N. Childs BSc. and D.Phil, 2013, Mechanical Design Engineering Handbook Butterworth-Heinemann; 1 edition.

Michael F. Ashby., 2010, Materials Selection in Mechanical Design, Fourth Edition 4th Edition, Butterworth-Heinemann.

BMCG 3233: MECHANICAL VIBRATION

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1. Apply the fundamental principles of vibration of one-and two-degree-of-freedom systems in engineering practice.
LO2. Solve the natural frequencies and mode shapes of a vibrating system.
LO3. Design techniques of vibration control.

SYNOPSIS

Fundamental of vibration. One-degree-of-freedom system: free vibration of an undamped and damped systems. Harmonically excited vibration: forced undamped and damped systems; unbalance rotating mass; base excitation. Two-degree-of-freedom system: natural frequencies and mode shapes. Continuous structures: beam, string and plates. Design of vibration suppression: vibration isolation and vibration absorber.

REFERENCES

a. Rao, S.S., 2011, *Mechanical Vibrations*, 5th edition: Prentice Hall.
b. Kelly, S.G., 2011, *Mechanical Vibrations*: *Theory and Applications*, Cengage Learning.
c. Meirovitch, L., 2010, *Fundamental of Vibration,* McGraw-Hill.
d. Inman, D.J., 2008, *Engineering Vibrations*, 3rd edition, Pearson Education Inc.
e. Kelly, S.G., 2006, *Schaum's Mechanical Vibrations*, McGraw-Hill.
f. Putra, A., Ramlan, R., and Ismail, A.Y., 2014, *Mechanical Vibrations*: Teaching Modul and Learning Series, UTeM.

BMCG 2011: MECHANICAL ENGINEERING LABORATORY II

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Observe discipline in attending laboratory sessions, applied safety precautions before, during and after conducting experiments

in terms of experimental procedures and aware of the general experimental ethics.

LO2 Plan, design and conduct experiments to prove a proposed hypothesis out of a given real and practical engineering problem.

LO3 Write a well organised, sensible and readable technical reports.

SYNOPSIS

Introduction to safety procedures in a laboratory. Hypothesis formulation. Design of experiments. Data Analysis. Use of graphical presentation techniques for experimental data. Error and uncertainty. Measurement Accuracy and Precision. Statistical analysis. Good laboratory report writing.

The experiments will be conducted in mechanical engineering laboratories that study fundamental engineering concepts in thermodynamics, fluid mechanics, solid mechanics and mechanical design.

REFERENCES

a. Wheeler, A.J. and Ganji, A.R., 2010. *Introduction to Engineering Experimentation*, 3rd Ed., International Edition, Pearson.

b. Alan, S.M., 2001. *Measurement and Instrumentation Principles*, 1st Ed., Butterworth-Heinemann

c. Holman, J.P. 2001. *Experimental Methods for Engineers*. 7th Ed., McGraw Hill.

YEAR 4 COURSES - COMMON CORE

BENG 2143: ENGINEERING STATISTICS

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Apply the concepts of data description, normal and sampling distributions, estimation and hypothesis testing, ANOVA, regression and non-parametric tests to solve mathematical problems.

LO2 Analyze engineering data using descriptive statistics.

LO3 Deduce statistical inference for engineering problems by using the techniques of estimation, hypothesis testing and regression.

SYNOPSIS

The outcome of this course is to deliver statistical techniques and tools for data analysis. The course begins with data

description. Then, students will be exposed to normal and sampling distributions, estimation and hypothesis testing for one and two populations. In addition, ANOVA, simple linear regression, multiple linear regression and polynomial regression will be taught in this course. Apart from that, students will learn non-parametric statistics. Finally, students will apply their knowledge in statistical software application which are widely used in the industry.

REFERENCES

a. Farah Shahnaz Feroz, Nortazi Sanusi, Hanissah Mohamad, 2019, A Student's Guide to Engineering Statistics, Penerbit UTeM.
b. Prem S. Mann, 2016, Introductory Statistics, 9th Edition, John Wiley & Sons.
c. Douglas C. Montgomery, George C. Runger, 2013, Applied Statistics and Probability for Engineers, 6th Edition, John Wiley.
d. Richard Johnson, John Freund, Irwin Miller, 2017, Miller and Freund's Probability and Statistics for Engineers, 9th Edition, Pearson-Prentice Hall.
e. Jay L. Devore, 2015, Probability and Statistics for Engineering and the Sciences, 9th Edition, Brooks Cole.
f. Sharifah Sara, Hanissah, Fauziah, Nortazi, Farah Shahnaz, 2008, Introduction To Statistics & Probability A Study Guide, Pearson-Prentice Hall.

BMCU 3935: INDUSTRIAL TRAINING

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Apply appropriate techniques and technical knowledge which relevant for student field of study.
LO2 Demonstrate the ability to adapt with working environment and practice working efficiently and ethically.
LO3 Display soft skill especially communication skill at all level.
LO4 Work effectively as an individual, team members and as a leader as well
LO5 Acquire new knowledge, life-long learning and aware to new technology.

SYNOPSIS

Students in third year are required to undergo industrial training for a minimum of 10 weeks at the designated organisation. During the industrial training, students are given continuous supervision by an industrial supervisor as

well as supervisor appointed by the faculty. Daily activities throughout the industrial training must be recorded in a e-logbook provided by the faculty, which will be evaluated by the supervisors. Five credit-hours are given for this industrial training. Students must show satisfactory attendance and discipline in order to pass this course. The faculty' supervisor may visit the students during the training period.

YEAR 4 COURSES – PROGRAMME CORE

BMCG 3713: THERMODYNAMICS II

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Apply the principles of thermodynamics (the first and the second laws of thermodynamics) to the optimal design of the basic energy conversion systems: power generation, refrigeration and air-condition.

LO2 Analyze energy conversion systems in the course of their operation, engineering design quantities and their effects on the basic performance characteristics.

LO3 Design the basic energy conversion systems, select working fluids and estimate the system efficiency.

SYNOPSIS

Thermodynamics II is a continuation of Thermodynamics I (BMCG 2713). Thermodynamics principles are applied to the analysis of power generation, refrigeration and air-conditioning systems. Energy and availability analysis (exergy), moist air properties and psychrometric chart and analysis are discussed in this course.

REFERENCES

a. Cengel, Y.A., & Boles, M.A., 2014, *Thermodynamics: An Engineering Approach*, 8th Edition, McGraw-Hill, Singapore.

b. Moran, M.J., Shapiro, H.N., Boettner, D.D. &
Bailey, M.B., 2014, *Fundamental of Engineering Thermodynamics*, 8th Edition, John Wiley & Sons, Inc.

c. Borgnakke, C., & Sonntag, R.E., 2012, *Fundamentals of Thermodynamics*, 8th Edition, John Wiley & Sons, Inc.

BMCG 3613: FLUID MECHANICS II

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Understand and apply the principles of fluid mechanics (Fluid kinematics and fluid dynamics, boundary layer theory, turbomachinery and similitude) to engineering problems

LO2 Analyze and evaluate the flow system (wall bounded, internal and external flow and turbomachinery) for discerning its characteristic and/or performance

LO3 Evaluate the flow system (wall bounded, internal and external flow and turbomachinery) for engineering application

SYNOPSIS

Introduction to the concept of fluid flow. Two dimensional ideal fluid flows. Viscous flow field and differential analysis of fluid motion. Vortex and Drag. Boundary layer theory, Von Karman Equation, Prandtl-Blasius solution. Dimensional Analysis and similarity. Working concepts and performance prediction of some fluid machineries such as pumps and turbines. Fundamental introduction of Computational Fluid Dynamics (CFD).

REFERENCES

a. Cengel, Y.A. & Cimbala, J.M., 2009, *Fluid Mechanics: Fundamentals and Applications*, 2nd Ed., McGraw-Hill, Singapore.

b. Munson, B.R., Young, D.F., & Okiishi, T.H., 2009, *Fundamentals of Fluid Mechanics*, 6th Ed., Wiley,

c. Crowe, C.T., Elger, D.F., Roberson, J.A. & Williams, B.C., 2008, *Engineering Fluid Mechanics*, 9th Ed, Wiley.

BMCG 3113: SOLID MECHANICS II

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Analyze plane-strain problems, strain measurements, stress-strain for pressure vessels and finally apply yield criteria to avoid elastic failure or yielding.

LO2 Analyze and solve the deformation of structural members based on double integration and energy methods.

LO3 Evaluate and solve buckling problem of structural members under compressive axial load and plastic collapse of mechanical members due to various loading conditions.

SYNOPSIS

Transformation of plane-strain and measurements of strain. Pressure vessels: thin, thick and compound cylinders. Yield criteria for ductile and brittle materials.

Deflection of beams. Strain energy: Energy concept and Castigliano's theorem. Column: instability and Euler's buckling load. Plastic deformation due to bending and torsional loadings.

REFERENCES

a. Beer, F.P, Johnston, E.R., Dewolf, J.T., and Mazurek, D.F., 2012, *Mechanics of Materials*, 6th edition. McGraw-Hill.
b. Hibbeler, R.C., 2011, *Mechanics of Materials*, SI Ed., Prentice Hall.
c. Benham, P. P., Crawford, R. J., and Armstrong, C. G., 1996, *Mechanics of Engineering Materials*, Longman Group, Ltd., UK.
d. Gere, J.M., 2012, *Mechanics of Materials*, CL Engineering

BMCG 3313: ENGINEERING DESIGN

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Explain and apply an appropriate design method at the particular design phase in the course of developing a practical solution of an engineering design problem.

LO2 Develop a practical design solution through a systematic investigation of the engineering design problem.

LO3 Communicate effectively in written, oral and visual means in a technical setting.

SYNOPSIS

This course covers Engineering Design process started from problems analysis, Formulating Design problems, Concept Design, Configuration Design, Parametric Design, Detail Design and Prototypes Development. Suitable methods such as QFD, Weighted Objective Method will be used at the particular design stage. Engineering Economics aspect of product, human factor, ethic and safety in design is included. Design for Manufacture and Assembly (DFMA) is a part of this course. In addition students are required to carry out teamwork project and communicate effectively in written and oral in the technical setting.

REFERENCES

a. Dieter, G.E., Schmidt, L.C, 2009, *Engineering Design*, 4th Edition, McGraw- Hill/Higher Education, Singapore.
b. Ulrich, K.T. and Eppinger, S.D., 2009, *Product Design and Development*, McGraw-Hill
c. Ullman, D.G., 2004, *The Mechanical Design Process*, McGraw-Hill Education (Asia), Singapore.

BMCG 4113: FINITE ELEMENT ANALYSIS

LEARNING OUTCOMES

At the end of this course, the student should be able to:

a. Describe appropriately the concept of finite elements method.
b. Develop finite elements model related to engineering problem analysis and solve it using finite elements modeler and analysis ANSYS software.
c. Analyse successfully complex problem to illustrate application of the method and write a report based on analysis of the result obtained.

SYNOPSIS

The purpose of this course is to expose the practice of structural analysis in engineering using finite elements. Introduction to finite elements method and understanding of direct method for 1-D elements including bar and beam elements. Understanding of formulation/variational methods including Potential Energy and Galerkin methods. Hands-on ANSYS software in order to build finite element model to solve the problems of linear statics analysis.

REFERENCES

a. Moaveni Saeed, 2008, Finite Element analysis: Theory and Application with ANSYS, 3rd Edition, Pearson, New Jersey.
b. Chandrupatla, T. R. and Belegundu, A. D., 2012, *Introduction to Finite Elements in Engineering*, 4th Edition, Prentice Hall, New Jersey.
c. Logan, D. L., 2012, *A First Course in the Finite Element Method*, 5th Edition, PWS Publishing Company, Boston.
d. Huebner, K. H., Dewhirst, D. L., Smith, D. E. and Byron, T. G., 2001, *The Finite Element Method For Engineers*, 4th Edition, John Wiley & Son Inc., New York.
e. Reddy, J. N., 2005, *An Introduction to Finite Element Method*, 3rd Edition, McGraw-Hill, Inc., New York.

BMCG 3011: MECHANICAL ENGINEERING LABORATORY III

LEARNING OUTCOME

At the end of this course, students should be able to:

LO1 Observe discipline in attending laboratory sessions, applied safety precautions before, during and after conducting experiments in terms of experimental procedures and aware of the general experimental ethics.
LO2 Plan, design and conduct experiments to prove a proposed

hypothesis out of a given real and practical engineering problem.

LO3 Write a well organised, sensible and readable technical reports.

SYNOPSIS

Introduction to safety procedures in a laboratory. Hypothesis formulation. Design of experiments. Data analysis. Use of graphical presentation techniques for experimental data. Error and uncertainty. Measurement accuracy and precision. Statistical analysis. Good laboratory report writing.

The experiments will be conducted in mechanical engineering laboratories that study fundamental engineering concepts in:-

A) THERMODYNAMICS
   i) Air-conditioning
   ii) Cooling Tower

B) FLUID MECHANICS
   i) Aerodynamic of common geometry
   ii) Drag Measurement
   iii) Pump Performance Test

C) SOLID MECHANICS
   i) Thin & Thick Cylinder
   ii) Curve & Davit Test

REFERENCES

a. Wheeler, A.J. and Ganji, A.R., 2010. *Introduction to Engineering Experimentation*, 3rd Ed., International Edition Pearson.

b. Cengel, Y. A. and Boles, M. A..2007. *Thermodynamics: An Engineering Approach*, 6th Ed., McGraw Hill.Singapore

c. Yuan, C.S., 2006, *Fluid Mechanics II*, Pearson Prentice Hall, Malaysia.

d. Hibbeler, R. C., 2007, *Solid Mechanics*, 7th Ed., Prentice Hall.

YEAR 5 COURSES - UNIVERSITY COMPULSORY

BTMW 4012: ENTREPRENEURSHIP TECHNOLOGY

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Apply the concept and importance of entrepreneurship to real world situation.

LO2 Demonstrate the techniques in digital entrepreneurship practiced by entrepreneurs to market a business.

LO3 Choose suitable business idea and process in developing a business plan for a small business.

SYNOPSIS

The course provides students with technological knowledge about entrepreneurship as well as the skills to turn such knowledge into practice. The teaching and learning (T&L) activities include case study and field work with the aim to inculcate entrepreneurship values and entrepreneurship acculturation with a view to successfully launch and subsequently manage their enterprises. Students will be exposed with the support systems available or government agencies in starting new ventures, including the tactics commonly employed by entrepreneurs starting a business. The course allows students to critically evaluate business in terms of technical feasibility, investment potential, and risks.

REFERENCES

a. Barringer, B.R., and Ireland, R.D., 2012, *Entrepreneurship,* 4th Edition, Pearson.
b. Scarborough, N.M., 2011, *Essentials of Entrepreneurship and Small Business Management*, 6th. Edition, Pearson.
c. UiTM Entrepreneurship Study, 2010, *Fundamentals of Entrepreneurship*, Pearson.

YEAR 5 COURSES - COMMON CORE

BMCU 3013: INTEGRATED DESIGN PROJECT

LEARNING OUTCOMES

At the end of this course, the student should be able to:

LO1 Design solution by synthesizing mechanical engineering knowledge that will solve complex mechanical engineering problem in accordance withrelevant standards.

LO2 Utilize modern engineering and IT tools in facilitatingsolutions to complex mechanical engineering problems with an understanding of the limitations.

LO3 Evaluate the impact of the design product, component or processes in term of safety, environmental and sustainability factors.

LO4 Demonstrate effectively teamwork skill in completing the IDP.

LO5 Apply project management and financial knowledge effectively in completing the IDP.

SYNOPSIS

Integrated Design Project is a course where students have to design a mechanical engineering project, including project management, project planning, project feasibility study, design selection, design costing and sizing, analysis and evaluation. The course focuses on the implementation and integration of product/conceptual design development to produce a comprehensive final technical report, including engineering proposals and drawings, specifications and bills of quantities, cost estimates of development projects given to students, working in groups. Apart from basic mechanical design, students are also required to integrate their knowledge of other engineering disciplines such as (but not limited to) structural analysis and design, including material selections, project scheduling techniques and sustainable development considerations into their overall project work. At the end of this course, the students will be able to comprehend the needs and requirements for product design procedures and are able to appreciate the importance of integration and synthesis of various disciplines of mechanical engineering knowledge.

REFERENCES

a. International Engineering Alliance, Graduates attributes and professional competencies, version 3, June 2013.
b. Richard G. Budynas and J. Keith Nisbett, Shigley's Mechanical Engineering Design (McGraw-Hill Series in Mechanical Engineering) 10th Edition, January 27, 2014
c. Peter R. N. Childs BSc. and D.Phil , 2013, Mechanical Design Engineering Handbook Butterworth-Heinemann; 1 edition (November 18, 2013).
d. Michael F. Ashby., 2010, Materials Selection in Mechanical Design, Fourth Edition 4th Edition, Butterworth-Heinemann; 4 edition (October 5, 2010).

BMCU 4972: FINAL YEAR PROJECT I

LEARNING OUTCOMES

After completing the course, students should be able to:

LO1 Formulate a problem statement and design a project methodology to fulfill objecives of the project.

LO2 Conduct initial measurements and/or predictive studies to meet objectives of the project.
LO3 Conduct initial experiments and/or numerical studies to meet the project objectives.
LO4 Present the results in written and oral format.

SYNOPSIS

The student needs to plan and implement the project individually that related to the mechanical engineering field. It covers problem statement, literature review, methodology to overcome the problem. The student needs to achieve the objective of the project and presented it in the report.

BMFG 4623: ENGINEERING MANAGEMENT AND ECONOMY

LEARNING OUTCOMES

At the end of this course, student should be able to:

LO1 Explain the principles and terminology of engineering economy, concepts of time value of money, and risk planning.
LO2 Apply the concepts, principle and techniques in project management and engineering economy.
LO3 Generate a comprehensive & viable Project Proposal and justify by a presentation in group discussion session.
LO4 Evaluate and select between alternatives using suitable methods such as Present Worth, Future Worth, Annual Worth Analysis; Breakeven & Payback Analysis.

SYNOPSIS

This course covers engineering economics and managing risk in an organization. Engineering economics discusses about the time value of money and interest relationships, which are useful to define certain project criteria that are utilised by engineers and project managers to select the best economic choice among several alternatives. Projects examined will include both product and service-producing investments. The effects of escalation, inflation, and taxes on the economic analysis of alternatives are also discussed. Management of risk incorporates the concepts of probability and statistics in the evaluation of alternatives. This allows management to determine the probability of success or failure of the project.

REFERENCES

a. Blank, L., and Tarquin, A., 2012, *Engineering Economy*, 7th Edition, McGraw Hill.

b. Sullivan, W.G., Wicks, E.M., and Koelling, C.P., 2012, *Engineering Economy*, 15th Edition, Pearson.
c. Park C.S., 2011, C*ontemporary Engineering Economics*, 5th Edition, Pearson.
d. Whitman, D., and Terry, R., 2012, *Fundamentals of Engineering Economics and Decision Analysis*, Morgan & Claypool Publishers.

BMCU 4022: ENGINEER AND SOCIETY

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Apply ethical principles and commitment, to professional ethics, responsibilities, and norms of engineering practice.

LO2 Apply reasoning informed by contextual knowledge to assess health, safety, and legal issues and its subsequent responsibilities, relevant to professional practice.

LO3 Understand the needs for sustainable development and the impact of engineering solutions on society and the environment.

SYNOPSIS

Role of engineer in Nation Building, evaluation of engineering, National development Role of engineers in society, laws related to public safety, health & welfare, future engineers, professionalism and codes of ethics, definition of professionalism, understanding engineering as a profession, ethical theories, IEM and BEM code of ethics. Ethical problem solving techniques analysis of issues in ethical problems, line drawing, flow charting, learn to handle conflicting problems, application in bribery and accepting gifts situation. Ethics practice in Occupational Safety and Health at work. Rights and responsibilities of engineers. Quality from engineering perspective. Carrier guidance and project management.

REFERENCES

a. The Institution of Engineer, Engineering Professionalism and Ethics, 4th Ed, 1995.
b. Fleddermann, C.B., 2008, *Engineering Ethics*, 3rd Ed, Prentice Hall.
c. Martin, M.W., & Schinzinger, R., 2005, *Ethics in Engineering*, 4th Ed, McGraw-Hill.
d. Harris JR, C.E., Pritchard, M.S., Rabin, M.J., 2003, *Engineering Ethics*, 2nd Ed, Thomson and Wadsworth.
e. Canning, J., 2007, Workplace Safety for Occupational Health and Safety (Safety at Work Series V4).
f. Safe Work in 21st Centuries (Educational and Training for the

Next Decade Occupational Health and Safety Personnel) National Academy Press, 2006.

g. Idrus, A., Sulaiman, S.A., Khamidi, M.F., 2010, *Engineers in Society*, Mc Graw Hill Education.

BMCU 4011: ENGINEERING SEMINAR

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Identify the professional engineering knowledge, practices and responsibilities.

LO2 Collect and sort relevant information with regards to the given technical talk.

LO3 Discuss current engineering issues and practices that impacts engineering professionals.

SYNOPSIS

A series of technical talks will be organised and the attendance is compulsory. The technical talks will dwell on engineering profession that relates to the technology advancement, economy issues, technopreneurship, environment, sustainability and safety aspects. Reflection of the seminar will be discussed in a forum and short report will be produced by the students.

YEAR 5 COURSES – PROGRAMME CORE

BMCG 4812: SUSTAINABILITY AND ENVIRONMENT

LEARNING OUTCOMES:

At the end of the course, students should be able to:

LO1 Explain the impact of pollution and climate changes towards the environment.

LO2 Apply the concept of sustainable development in engineering design, manufacturing and technologies abide with the current national laws, regulations and policies.

LO3 Demonstrate sustainability in solving complex engineering problems to achieve Sustainable Development Goals (SDGs).

SYPNOPSIS:

This course is an introductory course on sustainability and environment. It focuses on five main elements for sustainability; Water, Energy, Health, Agriculture and Biodiversity. Sustainable development

and its application in Malaysia in relation to the National Environmental Policy and Green Technology Policy are highlighted. Assessment tools such as Life Cycle Assessment, Carbon Footprint and Cleaner Production abide with the latest guideline, policies, laws and regulation. The application of engineering design, manufacturing and technologies towards sustainability and environment will be discussed.

REFERENCES

a. Robertson, M., 2014, *Sustainability Principles and Practice,* Routledge.
b. De Vries, B.J.M., 2012, *Sustainability Science*. Cambridge University Press.
c. Davis, M.L., and Masten, S.J., 2014, *Principle of Environmental Engineering and Science*. New York: McGraw-Hill.
d. Snedden, R., 2014, *Environmental Engineering and the Science of Sustainability*. New York: Crabtree Publishing.

BMCG 3223: CONTROL ENGINEERING

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Derive mathematical model and obtain transfer function of dynamic systems.
LO2 Explain stability of control system using standard techniques in times domain and analyze the time response of the system.
LO3 Utilize frequency response techniques and its relative stability to control the dynamic systems.

SYNOPSIS

Introduction to open loop and closed-loop control systems. Modeling of real system using differential equations to obtain the transfer function of dynamic systems and utilization of block diagrams for the closed-loop control system. Analysis of system for stability in time and frequency domains, final value, steady-state error, overshoot and settling time. Application of controller such as, P, PI and PID algorithms to achieve the desired system response.

REFERENCES

a. Mohd Khairi Mohamed Nor, Mohd Azli Salim, Md Fahmi Abd Samad @ Mahmood, Zairulazha Zainal, Nor Salim Muhammad, 2017, Control Engineering, Penerbit UTeM. (main text)
b. Andrea-Novel, B. and Lara, M., 2013, Control Theory for Engineers: A Primer, Springer-Verlag Berlin Heidelberg.
c. Dorf, R.C. and Bishop, R.H., 2011, Modern Control Systems, 12th Edition, Pearson Education Inc.

d. Jamaluddin, H., Yaacob, M.S. and Ahmad R., 2011, Introduction to Control Engineering, Johor Bahru, Johor: Penerbit UTM Press.
e. Nise, S.N. 2015, Control Systems Engineering, 7th Edition, Wiley.

BMCG 4743: HEAT TRANSFER

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Solve problems on steady state and unsteady state on one dimension and multiple dimension heat transfer.
LO2 Determine the heat transfer coefficient for natural or forced convection in dimensionless parameter in thermal system.
LO3 Determine of energy exchanges between black and grey surfaces at different temperatures.

SYNOPSIS

Introduction to heat transfer, steady state conduction-one dimension and multiple dimensions, unsteady state conduction. Numerical analysis for solving heat transfer problems, forced convection in laminar and turbulent flow on plate and pipe, natural convection, phase changes of heat transfer, thermal radiation on black body and surface, and boiling and condensation

REFERENCES

a. Chengel, Y.A., & Ghajar, A., 2014, *Heat and Mass Transfer: Fundamentals & Applications*, 5th Ed., McGraw-Hill.
b. Incropera, F.P. & Dewit, D.P., 2011, *Fundamentals of Heat and Mass Transfer*, 7th Ed., John Wiley & Sons.
c. Holman, J., 2009, *Heat Transfer*, 10th Ed., McGraw-Hill.

BMCG XXX3 ELECTIVE I
BMCG XXX3 ELECTIVE II

Refer to Year 5 & 6 Courses - Programme Elective

YEAR 6 COURSES – PROGRAMME CORE

BMCU 4984: FINAL YEAR PROJECT II

LEARNING OUTCOMES

At the end of this course, students will be able to:

LO1 Carry out project management based on the principle of engineering.
LO2 Conduct initial measurements and/or predictive studies to meet objectives of the project.
LO3 Analyze data and interpret results.
LO4 Present a full project report in written and oral forms.

SYNOPSIS

The student needs to plan and implement the project individually that related to the mechanical engineering field. It covers problem statement, literature review, methodology to overcome the problem. The student needs to achieve the objective of the project and presented it in the report.

BMCG XXX3 ELECTIVE III
BMCG XXX3 ELECTIVE IV

Refer to Year 5 & 6 Courses - Programme Elective

YEAR 5 & 6 COURSES - PROGRAMME ELECTIVE

BMCG 4713: RENEWABLE ENERGY SYSTEM

LEARNING OUTCOMES

At the end of this course the students should be able to:

LO1 Identify the sources of renewable energy, its technology and applications.
LO2 Analyze the potential for the renewable energy systems.
LO3 Evaluate the technoeconomics of stand-alone renewable energy hybrid system based on consumption data, local weather and current technology.

SYNOPSIS

Introduction to renewable energy. Solar photovoltaics, solar thermal systems, wind power, wave and tidal power, hydroelectric, biofuels, biomass, geothermal and ground-source heat pump, hydrogen and fuel cells.

REFERENCES

a. Boyle, G., 2012, *Renewable Energy: Power for a Sustainable Future*, 3rd Edition Oxford, University Press.
b. Kaltschmitt, M., Streicher, W., Wiese, A., 2010, *Renewable Energy: Technology, Economics and Environment*, 1st Edition, Springer.
c. Da Rosa, A.V., 2012, *Fundamentals of Renewable Energy Processes*, 3rd Edition, Academic Press.

BMCG 4723: REFRIGERATION AND AIR CONDITIONING SYSTEM

LEARNING OUTCOMES

At the end of this course, the students should be able to:

LO1 Design the vapor compression and vapor absorption refrigeration systems and estimate system performance.

LO2 List and discuss the relevancy of the working fluids such as steam and refrigerants (natural or otherwise) that are available and applied in the respective industries.

LO3 Design an air conditioning system using basic psychrometric theory that meet the internal thermal and thermal comfort requirements leading to building cooling load estimation and selection of ducting system.

SYNOPSIS

Introduction to the underlying thermodynamics principles, refrigeration system and air conditioning system. Carnot cycle and thermodynamics properties phase diagrams such as *p-h*, *T-s* and *p-v*. Vapour compression and absorption refrigeration systems. Types and use of refrigerants in the heating, ventilating and air conditioning (HVAC) system. Effect of green-house gases to the environmental sustainability. Psychrometric principles and thermal processes related to the HVAC. Interior design and thermal comfort configuration for domestic and industrial buildings. Cooling load estimation and ducting design for ventilation.

REFERENCES

a. McQuiston, F.C., 2011, *Heating, Ventilating and Air Conditioning Analysis and Design*, Wiley.

b. Arora, C.P., 2009, *Refirgeration and Air Conditioning*, 3rd Edition, Tata-McGrawHill, New Delhi.

c. Jones, W.P., 2001, *Air Conditioning*, 5th Edition, Butterwort Heinemann, Oxford.

d. Wang, S.K., 2009, *Handbook of Air Conditioning and Refrigeration*, 2nd Edition, MCGraw-Hill, New York.

BMCG 4733: POWERPLANT SYSTEM

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Analyze the performance of different cycles and component for power generation plant.

LO2 Analyze the performance of different combustion system using different fuel source.

LO3 Evaluate the power plant system and cooling tower performance.

SYNOPSIS

The course will involve the studies on the Thermodynamics review, Rankine Cycles,

Fossil-Fuel Steam Generator, Fuels and Combustion, Turbines, Condensate Feedwater System, Circulating Water System, Gas Turbines, Nuclear Energy, Reactors, Powerplant and Power Generation Influence on the Environment.

REFERENCES

a. Kiameh, P., 2011, Power Plant Equipment Operation and Maintenance Guide, McGraw Hill.
b. Woodruff, E., Lammers, H., and Lammers, T., 2011, *Steam Plant Operation*, 9th Ed., McGraw-Hill.
c. El-Wakil, M.M., 2002, *Powerplant Technology*, McGraw Hill.

BMCG 4613: COMPUTATIONAL FLUID DYNAMICS

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Explain the concept of major theories, approaches and methodologies used in CFD.

LO2 Conduct the actual implementation of CFD methods in using commercial CFD codes.

LO3 Interpret and present the results in an appropriate professional context.

SYNOPSIS

This course aims to introduce students with the basic steps and terminology that are associated with Computational Fluid Dynamics (CFD). Throughout the course, the students will learn the technique of obtaining the solution to fluid flow problems using theoretical concept and computational software. Historical development, philosophy and the significance of CFD are covered along with the governing equations of fluid dynamics. Other topics will also include the derivation of finite difference approximations to derivatives, discretizations and introduction to turbulence modelling.

REFERENCES

a. Anderson, J.D., 2006, Computational Fluid Dynamics The Basic with Application, McGraw-Hill: Singapore.
b. Tu J.Y., Yeoh G.H. and Liu C., 2018, Computational Fluid Dynamics: A Practical Approach, 3rd Edition, Butterworth-Heinemann
c. Zikanov O., 2019, Essential Computational Fluid Dynamics, 2nd Edition, John Wiley

BMCG 4623: FLUID POWER AND TURBOMACHINERY

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Apply fluid power and turbomachinery knowledge to solve engineering problems.
LO2 Analyze the performance of fluid power and turbomachinery system.
LO3 Gain and latest advanced knowledge of fluid power and turbomachinery technolog.

SYNOPSIS

The turbomachinery section covers classification of different types of turbomachines, basic relations of velocity diagrams, mass flow rates, energy and momentum equations for axial flow gas turbines and compressors. However, the Fluid Power section covers the introduction of the hydraulic and pneumatic systems, components and their working principles and performance. Furthermore, the level of understanding is enhanced to the system ancillaries, sensors, fluid power circuit design, and analysis and control. The computer software is used to design and simulate the fluid power application. REFERENCES

a. Dixon, S. L., 2005, *Fluid Mechanics and Thermodynamics of Turbomachinery*, Elsevier Butterworth-Heinemann, USA.
b. Peng, W.W., 2008, *Fundamental of Turbomachinery,* John Wiley & Son, USA.
c. Boyce, M.P., 2006, *Gas Turbine Engineering Handbook,* 3rd Edition, Gulf Proffesional Publishing, USA.
d. Ilango S. 2007. *Introduction to Hydraulics and Pneumatics*. Prentice Hall-India. New Delhi.
e. Esposito A. 2013. *Fluid Power with Applications .7*th Ed. Pearson Education Limited. UK.
f. Johnson, J.L. 2002. *Introduction to Fluid Power*. Delmar. New York.

BMCG 4123: ADVANCED SOLID MECHANICS

LEARNING OUTCOMES

At the end of this course the student should be able to:

LO1 Analyse and determine shear centre and stresses of structures due to unsymmetrical bending and torsional load.
LO2 Analyse and determine principal stresses by using imaging technique.
LO3 Analyse and evaluate the contact stresses due to contact between curved surfaces.

SYNOPSIS

Unsymmetrical bending theory, stresses in curved beams, shear centre and stress, torsion for open and closed cells thin-walled, photoelasticity, stresses in circular and square plate, and contact stresses.

REFERENCES

a. Beer, F.P., and Johnston, E.R, 2013, *Mechanics of Materials,* 4th Ed., McGraw-Hill.
b. Budynas, R.G., 1999, *Advanced Strength and Applied Stress Analysis*, McGraw-hill.
c. Hearn, E. J., 1997, *Mechanics of Materials Vol. I &II.*, Butterworth-Heinemann.
d. Benham, P.P., Crawford, R.J., and Armstrong, C.G, 1996, *Mechanics of Engineering Materials*, Longman Group, Ltd., UK.
e. Vable, M., 2004, *Mechanics of Materials*. Oxford University Press.
f. Solecki, R., and Conant, R.J., 2003, *Advanced Mechanics of Materials*. Oxford University Press.

BMCG 4133: FRACTURE MECHANICS

LEARNING OUTCOMES

At the end of this course the student should be able to:

LO1 Define the fracture mechanics and describe fracture mechanisms of materials and explain why structures fail by giving examples of structural failures occurred for the last few decades and recent years.

LO2 Define and differentiate the differences between stress concentration factor (SCF) and stress intensity factor (SIF) and explain how these parameters may be determined by using various methods and its relation with the K_{IC} of the material.

LO3 Determine, analyze and validate (or verify) data of fracture toughness of materials by using LEFM (Linear Elastic Fracture Mechanics) and EPFM (Elastic Plastic Fracture Mechanics) concepts.

LO4 Apply fracture criteria into structural design and determine fatigue life of engineering structures or components by using fracture mechanics approaches (either based on LEFM or EPFM concepts)

LO5 Examine and evaluate the fatigue phenomena of metallic materials and carry-out failure analysis (life prediction) by using stress-based and strain-based approaches

SYNOPSIS

Introduction to the subject of fracture mechanics and provides history and overview, Fundamental concepts of linear elastics and elastic-plastic fracture mechanics (LEFM and EPFM), Fracture toughness testing, Fatigue crack threshold and propagation equations, and Fatigue

behaviour and failure analysis of metallic materials based on Stress-based and Strain-based approaches.

REFERENCES

a. *Fundamentals and application of Fracture Mechanics* by T.L Anderson
b. *Mechanical Behaviour of Materials* by Norman E. Dowling
c. *Elementary Engineering Fracture Mechanics* by D. Broek.
d. *Fracture and Fatigue Control in Structure* by J.M. Barson and S.T. Rolfe.
e. *Principle of Fracture Mechanics* by R.J. Sanford.
f. *Fracture of Engineering Brittle Materials* by A.S. Jayatilaka.
g. *Annual Book of ASTM Standards and Handbooks of Peterson's Stress Concentration Factors* (By W.D Pilkey & D.F Pilkey) and SIFs Handbook by Tada, H., Paris, P.C., & Irwin, G.R

BMCG 4413: NON DESTRUCTIVE TESTING

LEARNING OUTCOMES

At the end of the course, the student should be able to:

LO1 Explain the current basic and some advanced principles of Non-Destructive Testing (NDT) techniques to satisfy complex engineering problems.

LO2 Recognize clearly the parameters that affect the sensitivity, reliability of the NDT techniques together with its strength and limitations in accordance to applicable standards.

LO3 Select the appropriate NDT methods in relation with industrial problem.

SYNOPSIS

This course is intended to introduce the Structural Health Monitoring (SHM) Systems and Technologies. It covers the system methodology that includes system components, data acquisition; the sensory technology; the SHM testing categories such as static field test, dynamic field test and etc; the SHM system design; vibration-based techniques for SHM; and case studies.

REFERENCES

a. Stepinski, T., Uhl, T., Staszewski, W., 2013, Advanced Structural Damage Detection: From Theory to Engineering Applications, John Wiley & Sons.
b. Mix, P.E., 2005, Introduction to Nondestructive Testing, 2thEditions, John Wiley & Sons.
c. Sansalone, M.J., Streett, W.B., 1997, Impact-Echo: Nondestructive Evaluation of Concrete and Masonry, Bullbrier Press

BMCG 4423: COMPOSITES AND ADVANCED MATERIALS

LEARNING OUTCOMES

At the end of the course, the student should be able to:

LO1 Explain the characteristics of materials that determine their properties.

LO2 Identify various classes of composites and advanced materials and their processing, properties and applications.

LO3 Apply the information provided in the course to properly identify, characterize, and select materials that satisfy a set of requirements.

SYNOPSIS

This course introduces students to composites and advanced materials in general, with the focus on their classifications, basic constituents, processing and applications. In addition, knowledge on the mechanical testing of fibre reinforced composites is included. This course also emphasizes on specific advanced materials including nanomaterials, biomaterials, surface engineering and powder metallurgy. The course also introduces some of the fundamental concepts in selecting and designing with composites and advanced materials in various engineering applications.

REFERENCES

a. Matthew, F.L., and Rawling, R.D., (2003). *Composite Materials: Engineering and Science*, Woodhead Publishing Limited.

b. Chawla, K.K., 2012, *Composite materials: Science and Engineering*, Springer.

c. Hodgkinson, John, 2000, *Mechanical testing of advanced fibre composites*, Woodhead Publishing.

d. Edelstein, Alan, S., and Cammaratra, R.C., 1998, *Nanomaterials: synthesis, properties and applications*. CRC Press.

BMCG 4433: METALLURGY

LEARNING OUTCOMES

At the end of the course, the student should be able to:

LO1 Explain clearly the structure, physical and mechanical behaviour of the metallic materials.

LO2 Describe properly the formation, fabrication and solidifications process, plastic deformation, strengthening mechanism, principle of recovery, recrystallization and grain growth.

LO3 Correlate the composition, microstructure and heat treatment

processes by interpretation of Ferum-Carbide phase diagrams and transformation diagrams system appropriately of metallic materials.

SYNOPSIS

Physical metallurgy: crystal structure and properties of pure metals, solidification; strengthening mechanisms; recovery, recrystallization and grain growth; ferum-carbide phase diagram; TTT diagrams; heat treatment of steel; non-ferrous metals and its alloy; heat treatment of non-ferrous metals; properties of metallic materials and its alloy, corrosion and prevention of metallic materials .

Mechanical metallurgy: stress and strain; elastic behavior; theory of elasticity; true stress and true strain; effect of heat/temperature on strain rate and stress flow; metallurgy structure; mechanic testing for metallic materials for stress, hardness, impact and creep; fundamental of mechanical working for metallic materials.

REFERENCES

a. George, E.D., 2013, *Mechanical Metallurgys*, 3th Ed. in SI Units, Tata McGraw-Hill.
b. V. Raghavan, 2006, *Physical Metallurgy Principles And Practice* 2nd Ed.. Prentice Hall.
c. Smith, W.F., 2010, *Principles of Materials Science and Engineerings*, 5th Ed., McGraw Hill.
d. Hertzberg, R.W., 1996, *Deformation and Fraxture Mechanics of Engineering Materials,* 4th Ed., Willey.

BMCG 4313: MECHANISM DESIGN

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Describe the concept and the process of designing a mechanism system.

LO2 Analyze the motion characteristics of the machine analytically, graphically or computationally.

LO3 Synthesize mechanisms according to motion requirement.

SYNOPSIS

This course is to introduce the principles of designing mechanisms, aided by the use of computer applications. Students will investigate the kinematics and dynamics of machineries. Topics include cam and cam follower design, gear kinematic analysis, and linkage synthesis.

REFERENCES

a. Myszka, Dave, 2012, *Machines & Mechanisms: Applied Kinematic Analysis*, 4th ed., Prentice Hall, Upper Saddle River, New Jersey.

b. Norton, Robert, 2012, *Design of Machinery*, 5th ed., McGraw-Hill, New York.
c. Uicker Jr., J.J., Pennock, G.R., and Shigley, J.E., 2003, *Theory of Machines and Mechanisms*, 3rd ed., Oxford University Press, New York.

BMCG 4323: RAPID PROTOTYPING TECHNOLOGY

LEARNING OUTCOMES

At the end of this course, the students should be able to:

LO1 Explain the the contemporary issues of prototype development technology.
LO2 Apply suitable technology for prototype and product development.
LO3 Demonstrate the engineering and basic management knowledge related to prototype and product development.

SYNOPSIS

This course introduces essential tools and techniques in concurrent product and process development. It explains and discusses the functions and roles of time compression technologies such as rapid prototyping, CAD, and reverse engineering within product development. Comparison between additive and subtractive layer manufacturing is included. An overview of several RP, RE, and CAD systems current application and future trends are also discussed. The application of solid modeling and surface modeling, together with STL file generation in component design is analyzed. Reverse engineering systems, rapid tooling and rapid manufacturing techniques are compared and discussed.

REFERENCES

a. Thompson, R., 2011, *Prototyping and Low-Volume Production: The Manufacturing Guides*, Thames and Hudson.
b. Bartolo, P.J., 2011, *Stereolithography: Material, Processes and Applications*, Springer.
c. Gibson, I., Rosen, D.W., & Stucker B., 2009, *Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing*, Springer.

BMCG 4333: DESIGN QUALITY AND RELIABILITY

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Identify and recognize the essential techniques to assess and improve process and/or product quality and reliability.

LO2 Develop and evaluate the quality and reliability issues through Total Quality Management and Reliability model.

LO3 Analyze and develop the basic concepts and techniques of modern reliability engineering tools.

SYNOPSIS

This course introduces essential techniques in quality and reliability issues in design. The students will be exposed to the Total Quality Management concept, application of quality function deployment, design of experiment (Taguchi method) for product and process design. It also covers topics such as product reliability, application of fault tree analysis, failure distribution method and reliability prediction analysis.

REFERENCES

a. Krajewski, L.J., Ritzman, L.P., & Malhotra, M.K., 2007, *Opeartion Management: Process and Value Chains*, Prentice Hall.

b. Smith, D.J., 2011, *Reliability, Maintainability and Risk*, Elsevier Ltd.

c. Ebeling, C.E., 2010, *An Introduction to Reliability and Maintainability Engineering*, The McGraw-Hill Companies, INC.

BMCG 4343: DESIGN OPTIMIZATION

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Understand and formulate optimization problems in engineering design.

LO2 Apply an engineering package to optimize the design.

LO3 Explore optimization cases in industry.

SYNOPSIS

This course covers Mathematical modeling of engineering design problems for optimization. Boundedness and monotonicity analysis of models. Differential optimization theory for unconstrained and constrained problems, and selected numerical algorithms for continuous nonlinear models. Emphasis on the interaction between proper modeling and computation. Students propose design term projects from various disciplines and apply course methodology to optimize designs.

REFERENCES

a. Papalambros, P.Y., and Wilde, D.J., 2000, P*rinciples of Optimal Design: Modelling and Computation*, Cambridge University Press.

b. Arora, J., 2011, *Introduction to Optimum Design* (Third Edition), Academic Press.

c. Venkataraman, P., 2009, *Applied Optimization with MATLAB Programming* (2nd Edition), Wiley.

d. Rao, S.S., 2009, Engineering Optimization: Theory and Practice, Wiley.

BMCG 4513: ADVANCED COMPUTER AIDED DESIGN

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Understand and apply the fundamentals of surface modeling in CAD using the tools and workbenches studied in the class in relation to the design and automotive industries.

LO2 Develop 3D surface models in the process of concept design generation and also for the engineering design detail data development.

LO3 Analyze the surface modeling data using the surface analysis tools for further engineering design and development process.

SYNOPSIS

This course will empower the students with fundamental knowledge and technical skills of 3D surface modeling skills using industry-proven 3D mechanical CAD software. The students will learn about the different techniques for creating surface models with emphasis on design intent. Other topics include surface analysis, A-class surface, generation of complex shape, surface requirement in mechanical applications.

REFERENCES

a. Dassault Systeme, 2006, *CATIA: Generative Shape Design Fundamentals*; Lecture
b. Guide CATIA V5R16, France.
c. Dassault Systeme, 2006, *CATIA: FreeStyle Fundamentals; Lecture Guide CATIA V5R16*, France.
d. Dassault Systeme, 2006, *CATIA: FreeStyle Sketch Tracer; Lecture Guide CATIA V5R16*, France.
e. Dassault Systeme, 2006, *CATIA: Digital Shape Editor; Lecture Guide CATIA V5R16*, France.

BMCG 4213: VIBRATION MONITORING OF ROTATING MACHINERY

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Describe the principle of vibration measurement, signal processing and the standards used in rotating machineries fault diagnosis.

LO2 Classify the fault criteria in rotating machineries.

LO3 Diagnose and justify the type of faults.

SYNOPSIS

The course emphasizes on the basic vibration measurement involving rotating machineries. It covers the basic signal processing especially relating to the time domain and frequency domain analyses. Several fault diagnosis involving unbalance, alignment, looseness, rolling element bearing analysis, gearbox analysis, pumps, fans and compressors are covered in the course. The course also highlights the right way to the vibration analysis process and the setting of alarm limits. Several related ISO standards are also briefly introduced.

REFERENCES

a. Vance, J., Zeidan, F., & Murphy, B., 2010, *Machinery Vibration and Rotordynamics*, 1st Ed., John Wiley & Sons, USA.
b. Adams, M.L., 2009, *Rotating Machinery Vibration: From Analysis to Troubleshooting*, 2nd Ed., CRC Press, USA.
c. Muszynska, A., 2005, *Rotordynamics (MECHANICAL ENGINEERING)*, CRC Press, USA.
d. Bently, D.E. & Hatch, C.T., 2003, *Fundamentals of Rotating Machinery Diagnostics (Design and Manufacturing)*, 1st Ed., American Society of Mechanical Engineers, USA.
e. Randall, R.B., 2011, *Vibration-based Condition Monitoring: Industrial, Aerospace and Automotive Applications*, 1st Ed., John Wiley & Sons, USA.

BMCG 4813: CONDITION BASED MAINTENANCE

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Differentiate different maintenance strategies.
LO2 Describe the fundamental aspect of each condition monitoring technologies including operating and measurement principle.
LO3 Apply the monitoring technologies to diagnose the machinery faults by means of field measurement or data interpretation.

SYNOPSIS

This course introduces the maintenance philosophy in general and focuses more on the philosophy of the condition based maintenance. It also covers the basic techniques used in condition monitoring such as vibration analysis, oil and wear debris analysis, thermography and ultrasonic techniques. By introducing these common techniques, students are exposed on how to decide the best diagnosis method to determine the faults. Sometime,

one technique may not be able to determine the faults and requires integrated condition monitoring which involves various techniques.

REFERENCES

a. Williams, J.H., Davies, A., & Drake, P.R., 1994, *Condition-based Maintenance and Machine Diagnostics*, 1st Ed., Chapman and Hall, USA.
b. Chang, F.K., 2011, *Structural Health Monitoring 2011: Condition Based Maintenance and Intelligent Structures*, 1st Ed., Destech Pubns Inc, USA.
c. Rao, B.K.N., 1996, *Handbook of Condition Monitoring*, 1st Ed., Elsevier Advanced Technology, UK.
d. Davies, A., 1998, *Handbook of Condition Monitoring: Techniques and Methodology*, Chapman & Hall, UK.
e. Yardley, E.D., 2002, *Condition Monitoring: Engineering the Practice*, John Wiley & Sons, USA

BMCG 4823: RELIABILITY, MAINTAINABILITY AND RISKS

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Analyze the failure and reliabilty of equipment or component by using statistical method.

LO2 Determine the maintainability of equipment.

LO3 Determine the plant safety system.

SYNOPSIS

The course provides knowledges in analyzing the reliability of machine and component. Generate failure statistic of machine or components. . Decision making analysis (Pareto and trend analysis). Analysis and assessment of component reliability (Weibull distribution and graphic analysis). Maintainability analysis and Fault tree analysis, for safety risk assessment which include : (a) symbols and construction, (b) minimum cut sets, (c) top event quantification, (d) importance measures. The Reliability Block Diagram (RDB): representation and assessment of the reliability of simple configurations. Maintainability analysis. Estimating system repair times.

REFERENCES

a. Smith, D.J., 2011, *Reliability, Maintainability and Risk: Practical Methods for Engineers Including Reliability Centred Maintenance and Safety-Related Systems*, 8th Ed., Butterworth-Heinemann.
b. Stapelberg, R.F., 2009, *Handbook of Reliability, Availability, Maintainability and Safety in Engineering Design*, 1st Ed., Springer.

c. Plucknette, D., 2009, *Reliability Centered Maintenance using RCM Blitz*, Reliabilityweb.com.
d. Dhillon, B.S., 2006, *Maintainability, Maintenance, and Reliability for Engineers*, CRC Press.

BMCG 4833: WEAR DEBRIS AND OIL ANALYSIS

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Conduct analysis of lubrication and machinery deterioration using wear debris and oil analysis.

LO2 Investigate machinery lubrication problem using wear debris and oil analysis to predict machinery failure.

LO3 Select appropriate technique in wear debris and oil analysis indiagnosis the lubrication and machinery problem.

SYNOPSIS

The course provides knowledge in lubrication fundamentals, lubricant additive properties, lubricant perfomance properties, and deteriotation condition due to the process. It focuses on condition monitoring techniques using wear debris and oil analysis. The technique enables the prediction of machine deterioration through wear particle counts, particle shape analysis, quantity analysis and surface condition of particles. In addition, oil analysis is capable of giving the condition of lubricants being used in the machine and components such as gearboxes and bearing. The status of the additives of the lubricants can also be determined in order to know the deterioration performance of the lubricants. Through contamination analysis, the source of the contaminants can be detected in order to ensure the rate of contamination can be controlled and eliminated. Through the combined analysis, decision can be made on the next course of actions to be taken on the analyzed machine component. This course will extend to cover the best practice technique of lubricant management.

REFERENCES

a. Hunt, T. M., 1992, *Handbook of wear debris analysis and particle detection in liquids*, Elsevier Science Publisher..
b. Hunt, T. M., 2004, *Oil Analysis*, Coxmoor Publishing Company's.
c. Yardley, E. D., 2002, *Condition monitoring: Engineering the practice*,Wiley
d. M.J.Neale, 2001, Lubrication and reliability handbook, Butterworth-Heneimman

e. Davies, A., 1996, *Handbook of condition monitoring*, Thomson science.

BMCG 4843: STRUCTURAL HEALTH MONITORING

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Describe fundamental principles of current state of SHM process and technology.

LO2 Assess structural integrity loss of mechanical structure.

LO3 Suggest the best SHM strategy to sustain mechanical structures.

SYNOPSIS

This course is intended to introduce the Structural Health Monitoring (SHM) Systems and Technologies. It covers the system methodology that includes system components, data acquisition; the sensory technology; the SHM testing categories such as static field test, dynamic field test and etc; the SHM system design; vibration-based techniques for SHM; and case studies.

REFERENCES

a. Stepinski, T., Uhl, T., Staszewski, W., 2013, *Advanced Structural Damage Detection: From Theory to Engineering Applications*, John Wiley & Sons.

b. Mix, P.E., 2005, *Introduction to Nondestructive Testing*, 2nd Editions, John Wiley & Sons.

c. Sansalone, M.J., Streett, W.B., 1997, *Impact-Echo: Nondestructive Evaluation of Concrete and Masonry*, Bullbrier Press.

BMCG 4913: VEHICLE DYNAMICS

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Explain the basics of vehicle handling/ride and primary factors that affect it.

LO2 Develop physical and mathematical model to predict the dynamic response of a vehicle.

LO3 Design vehicle components and subcomponents that meet certain vehicle dynamics performance criteria.

SYNOPSIS

This course is intended to discuss an introduction and the basic concept of vehicle dynamics, fundamental approach towards vehicle dynamics modeling, vehicle response to various driver and ambient inputs, road loads, mechanics of tyre, relation between ride and handling, steering and suspension system.

REFERENCES

a. Dukkipati, R.V., Pang, J., Qatu, M.S., Sheng, G., & Shuguang, Z., 2008, Road Vehicle Dynamics, 1st Ed., SAE International, Warrendale, PA, USA.
b. Wong, J.Y., 2008, Theory of Ground Vehicles, 4th Ed., John Wiley & Sons.
c. Rajamani, R., 2012, Vehicle Dynamics and Control, 2nd Ed., Springer, New York, USA.

BMCG 4923: AUTOMOTIVE TECHNOLOGY

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Describe the classifications and fundamental concept of automotive system.

LO2 Analyse the assembly and disassembly process of automotive system or components.

LO3 Review the technological advances in any automotive system in modern vehicle supporting Energy Efficient Vehicle (EEV).

SYNOPSIS

This course covers automotive configurations, basic operation of automotive system and components such as engine and power train system, electric and electronic system, suspension, brake, steering, fuel and lubricants.

REFERENCES

a. Halderman, J.D., 2009, Automotive Technology: Principles, Diagnosis and Services, 3rd Edition, Prentice Hall.
b. Erjavec, J., 2010, Automotive Technology 5e: A Systems Approach, 5th Edition, Thomson Delmar Learning, New York.
c. Duffy, J.E., 2009, Modern Automotive Technology, 7th Edition, Goodheart-Willcox Publisher.

BMCG 4933: VEHICLE POWERTRAIN SYSTEMS

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Explain the principles behind the design of vehicle powertrain components and systems.

LO2 Use mathematical programming for examination of performance and energy usage.

LO3 Analyse on the overall vehicle performance using a system approach that focuses on the integration and interaction of all powertrain components

SYNOPSIS

Transmission design engineering has been enriched by numerous variants such as automatic transmission, continuous variable transmission, torque converter, clutch

transmission and transmission for all-wheel drive. The purpose of this course is to describe the development of motor vehicle transmission as an ongoing part of the vehicle development system. The contents including discussing and introducing the basic concept of automotive power train, fundamental approach towards automotive engine performance, power conversion, engine and transmission matching, principle design of transmission system, vehicle response to various engine and transmission configurations, automatic and manual transmission, brakes and wheel, and power train technology. New era of power train technology will also be analyzed.

REFERENCES

a. Mashadi, B., and Crolla, D., 2012, AutomotiveVehicle Powertrain Systems, John Wiley & Sons Ltd.
b. Naunheimer, H., Bertsche, B., Ryborz, J., and Novak, W., 2011, Automotive of Vehicle Dynamics, Society of Automotive Engineers: USA.
c. Nam, K.H., 2010, AC Motor Control and Electric Vehicle Applications, CRC Press.

BMCG 4943: INTERNAL COMBUSTION ENGINE

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Explain the fundamental concepts of the internal combustion engine.
LO2 Explain the combustion process, engine cycles, operating parameters and emissions produced by internal combustion engine.
LO3 Use analytical and computational approaches for analyzing internal combustion engine.

SYNOPSIS

The course introduces students to the fundamentals of internal combustion engines (ICEs). Thermodynamic operating principles are used to solve problems on spark ignition and compression ignition engines that operate on four-stroke or two-stroke cycles. The scope of the course includes all ICEs with an emphasis on reciprocating engines used in automobiles and similar applications. Topics include operating characteristics, engine cycles, thermochemistry and fuels, air and fuel induction, fluid motion within combustion chamber, combustion, exhaust flow, emissions and air pollution, heat transfer in engines, and friction and lubrication. The latest automotive technologies are also discussed in relevant topics such as hybrid vehicles,

higher voltage electrical systems, and electronic valve actuation.

REFERENCES

a. Ganesan, V., 2010, Internal Combustion Engines, 3rd Edition, Tata-McGraw Hill, New Delhi.
b. Bosch, R., 2006, Gasoline-Engine Management: Systems and Components, 3rd Ed., Professional Engineering publishing.
c. Pulkrabek, W.W., 2004, Engineering Fundamental of the Internal Combustion Engine, 2nd Ed., Prentice Hall, New Jersey.

BMCG 4953: VEHICLE SYSTEM MODELLING & SIMULATION

LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Develop mathematical models for a given vehicle application or analysis.
LO2 Verify the models using vehicle dynamics simulation software.
LO3 Simulate and evaluate the performance of vehicle system.

SYNOPSIS

This course is intended to introduce vehicle dynamics modeling and simulation. Mathematical models will be developed in order to predict the vehicle behaviour in longitudinal, lateral and vertical directions. Tire modeling will cover both linear and non-linear tire models. Validation and limitations of vehicle models will be discussed. These models will be used to evaluate the performance of tire, ride and handling. For vehicle handling assessment, steady-state and transient tests will be described. Modeling and simulation of vehicle systems in MATLAB/SIMULINK environment will be used extensively in class notes and assignments.

REFERENCES

a. Wong, J.Y., 2008, Theory of Ground Vehicles, 4th Ed., John Wiley and Sons Inc, USA.
b. Rajamani, R., 2012, Vehicle Dynamics and Control, 2nd Ed., Springer, New York, USA.
c. Dukkipati, R.V., Pang, J., Qatu, M.S., Sheng, G., & Shuguang, Z., 2008, Road Vehicle Dynamics, 1st Ed., SAE International, Warrendale, PA, USA.

LANGUAGE ELECTIVE COURSES (YEAR 2)

BLLW 1222: MANDARIN LANGUAGE I

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Demonstrate the ability to converse in basic Mandarin with correct and accurate pronunciation.

LO2 Identify basic vocabulary and sentence patterns.

LO3 Interpret the information in the simple text and construct sentences with correct grammar.

SYNOPSIS

This subject is designed for students who do not have prior knowledge in Mandarin. It provides students with the foundation of knowledge to enable them to understand and respond in the oral and written forms. This subject encompasses the listening, speaking, reading and writing components. This subject aims to help students to obtain enough exposure of the Mandarin phonetics (Han Yu Pin Yin). The basic grammar introduced is related to the language used daily by the Chinese. Particular care is also taken to ensure the development of verbal communication and written skills in Mandarin.

REFERENCES

a. Cheong, K. M., 2015, *Mari belajar Mandarin*. Penerbit: Universiti Teknikal Malaysia Melaka.

b. Ang, L.H. & Ooi, B.L., 2012, *Basic Chinese for everyone*. Selangor: Pelanduk Publications.

c. Wu, J. & Bai, L., 2011, *Chinese grammar step by step*. Singapore: Cengage Learning Asia Pte Ltd.

d. Soh W. N., Chia T.H., San, L. & Mok, S. S., 2009, *Conversational Mandarin Chinese for non-native speakers*. Selangor: Xueer publisher.

e. Alison, L.M., 2006, *The first 100 Chinese characters*. Hong Kong: Tuttle Publishing.

BLLW 1242: KOREAN LANGUAGE I

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Identify Hangeul (Korean alphabet) and read in Korean language.

LO2 Interpret the information in the simple text and construct sentences with correct grammar.

LO3 Demonstrate basic conversation in Korean with correct pronunciation.

SYNOPSIS

This subject is designed for students who do not have prior knowledge in Korean. It provides students with the foundation of knowledge to enable them to understand and respond in the oral and written forms. This subject encompasses the listening, speaking, reading and writing components. This subject aims to help students to obtain basic knowledge about Korean language. The basic grammar introduced is related to the language used daily by the Korean. Particular care is also taken to ensure the development of verbal communication and written skills in Korean.

REFERENCES

a. K. Park, 2015, *Essential Korean Vocabulary*. Tuttle Publishing.
b. P. Jun Seok & S. Chaemin, 2015, *Korean: Language 1 for Beginners*. Institut Terjemahan & Buku Malaysia.
c. J. Hong & W. Lee, 2008, *Korean for Dummies*. Wiley Publishing Inc.

BLLW 1212: ARABIC LANGUAGE I

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Demonstrate the ability to converse in Arabic with correct and accurate pronunciation and respond to it accordingly.
LO2 Identify basic vocabulary and demonstrate writing skills.
LO3 Interpret the information in the simple text and construct sentences with correct grammar.

SYNOPSIS

This subject is designed for students who do not have prior knowledge in Arabic. It provides students with the foundation of knowledge to enable them to understand and respond in the oral and written forms. This subject encompasses the listening, speaking, reading and writing components. This subject aims to help students to obtain enough exposure of the Arabic language skills. The basic grammar introduced is related to the language used daily in conversation. Particular care is also taken to ensure the development of verbal communication and written skills in Arabic.

REFERENCES

a. M. Helmi Omar & Ab Rahim Ibrahim, 2016, *Mari Belajar Bahasa Arab*. Melaka, Universiti Teknikal Malaysia Melaka.
b. Che, R. M. & Norhayuza, M., 2011, *Kosa kata Arab: Teori dan aplikasi*. Serdang, Selangor: Penerbit Universiti Putra Malaysia.
c. Mohd, A. G., 2010, *Kamus mini: Asas perbualan dan perkataan*. Kajang, Selangor: Awfal Enterprise.

d. Noorli, M. N., 2012, *Bahasa Arab mudah*. Kota Bharu, Kelantan: AE Books Enterprise.
e. Othman, A., 2009, *Cara mudah belajar bahasa Arab (Buku 3)*. Kuala Lumpur: Al-Hidayah Publication.
f. Ragy, I., 2009, *Learn Arabic the fast and fun way*. New York: Barron's Educational Series.

BLLW 1252: GERMAN LANGUAGE I

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Demonstrate the ability to converse in German with correct and accurate pronunciation and respond to it accordingly.
LO2 Identify basic vocabulary and demonstrate writing skills.
LO3 Interpret the information in the simple text and construct sentences with correct grammar.

SYNOPSIS

This subject is designed for students who do not have prior knowledge in German. It provides students with the foundation of knowledge to enable them to understand and respond in the oral and written forms. This subject encompasses the listening, speaking, reading and writing components. This subject aims to help students to obtain basic exposure of the German phonetics. The basic grammar introduced is related to the language used daily by the German. Particular care is also taken to ensure the development of verbal communication and written skills in German.

REFERENCES

a. H. Aufderstrasse, H. Bock, M. Gerdes, M. Gerdes, J. Mueller, H. Mueller, 2003, *Themen 1 aktuel*, Hueber Publishing.
b. Funk, H. Etl., 2002, *Geni@l Deutsch als Fremdsprache fuer Jugendliche*. Berlin, Germany Langenscheidt

BLLW 1232: JAPANESE LANGUAGE I

LEARNING OUTCOMES

At the end of the course, students should be able to:

LO1 Demonstrate the ability to converse in Japanese with correct and accurate pronunciation and respond to it accordingly.
LO2 Identify basic vocabulary and demonstrate writing skills.
LO3 Interpret the information in the simple text and construct sentences with correct grammar.

SYNOPSIS

This subject is designed for students who do not have any background in Japanese. It provides students with the knowledge to enable them to understand and

communicate in the oral and written forms. This subject encompasses the listening, speaking, reading and writing components. The grammar introduced is related to the language used daily by the
Japanese. In addition, two types of Japanese language writing systems; Hiragana and Katakana are also introduced. Students are also exposed to elementary reading materials.

REFERENCES

a. Minna no Nihongo shokyu 1, 2012, (Beginners 1) Sentence Pattern Workbook. 3A Network
b. Minna no Nihongo shokyu 1, 2012, (Beginners 1) Translation & Grammatical Notes. 3A Network.
c. The Association For Overseas Technical Scholarship (AOTS), 2009, Shin Nihongo No Kiso 1-English Translation. Asian Edition.
d. The Association for Japanese-Language Teaching, 2009, Shin Nihongo No Kiso 1-English Translation. Asian Edition.

GENERAL ELECTIVE COURSES (YEAR 3)

BIPW 3112: CRITICAL AND CREATIVE THINKING (PEMIKIRAN KRITIS DAN KREATIF)

LEARNING OUTCOMES

Pada akhir kursus ini, pelajar akan dapat:

LO1 Mengenal pasti prinsip asas kemahiran pemikiran kritis dan kreatif.

LO2 Menganalisis maklumat yang dikumpul dan dicerap untuk membuat keputusan.

LO3 Membentuk konsep atau idea penyelesaian baru.

SYNOPSIS

Mata pelajaran ini direka untuk memberi pendedahan kepada pelajar tentang prinsip-prinsip asas dalam pemikiran kritis dan kreatif. Pelajar akan mengaplikasikan kaedah pemikiran kritis dan kreatif dalam penyelesaian masalah melalui pendekatan pembelajaran berpusatkan pelajar termasuk pendekatan pembelajaran berasaskan permasalahan (PBL). Pelajar akan dipandu di dalam projek akhir di mana penganalisaan kehendak pasaran akan datang akan dilaksanakan dan cadangan penyelesaian adalah berasaskan produk keperluan pasaran dari pelbagai perspektif dan pemikiran di luar kotak (out of the box).

REFERENCES

a. Aziz Yahya, Aida Nasirah Abdullah, Hazmilah Hasan, Raja Roslan Raja Abd Rahman., 2011, *Critical and Creative Thinking Module 2*. Melaka. Penerbit UTeM.
b. Buzan, T., 2009, *Mind maps for business : revolutionise your business thinking and practice*, New York : Pearson BBC Active.
c. Claxton, G., Lucas, B., 2007, *The Creative Thinking Plan*, London: BBC Books.
d. Fisher, A., 2011, *Critical Thinking: An Introduction*. London: Cambridge University Press.

BIPW 4122: NEGOTIATION SKILLS (KEMAHIRAN PERUNDINGAN)

LEARNING OUTCOMES

Pada akhir mata pelajaran ini, pelajar akan dapat:

LO1 Mengenalpasti konsep-konsep asas dalam proses perundingan menggunakan amalan komunikasi berkesan.
LO2 Membuat kesimpulan terhadap teknik-teknik perundingan yang terbaik berdasarkan pendekatan teori yang pelbagai.
LO3 Menyelesaikan isu-isu perundingan berdasarkan teknik-teknik kemahiran perundingan yang berkesan berasaskan pelbagai situasi

SYNOPSIS

Kursus ini akan membincangkan konsep asas perundingan, teknik berfikiran secara kritis dan kreatif, teknik komunikasi berkesan dan teknik mendengar dan menyoal secara berkesan. Pelajar turut didedahkan dengan pengetahuan dan kemahiran yang diperlukan untuk menjalankan dan meguruskan proses perundingan pelbagai secara berkesan. Selian itu, kemahiran berfikir secara kritis dan kreatif, serta kemahiran komunikasi berkesan yang diperlukan bagi menjalankan proses perundingan juga akan dibincangkan.

REFERENCES

a. Lemiwki, R., Barry, B. & Saunders, D., 2016, Essentials of negotiation. USA: McGraw Hill Education.
b. Fisher, R & Ury., 2011, Getting to YES: Negotiating agreement without giving in. Third Edition. Penguin Books.
c. Covey, S., 2013, The 3rd Alternative: Solving Life's Most Difficult Problems. New York: Free Press.

BIPW 1152: INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY

(PSIKOLOGI INDUSTRI DAN ORGANISASI)

LEARNING OUTCOMES

Pada akhir mata pelajaran ini, pelajar akan dapat:

LO1 Menghubung kait proses persekitaran dan teori di tempat kerja dalam dunia organisasi dan perindustrian.

LO2 Mempamerkan ciri-ciri kepimpinan dalam aktiviti tugasan kumpulan

LO3 Memberi tindak balas terhadap peranan dan tanggungjawab sebagai seorang bakal pekerja di dalam organisasi.

SYNOPSIS

Kursus ini memberi pendedahan kepada aspek psikologi dalam dunia pekerjaan dalam sektor industri serta permasalahan yang berhubung dengan tingkah laku dalam organisasi. Terdapat beberapa topik yang dibincangkan termasuk isu-isu semasa dalam psikologi di tempat kerja, perancangan personel, tekanan di tempat kerja dan psikologi kejuruteraan..

REFERENCES

a. Azlina Abu Bakar, 2013, Psikologi Industri dan Pengurusan Sumber Manusia. Terengganu: Penerbit Universiti Malaysia Terengganu.

b. Schultz & Schultz, Duane, 2010, Psychology and Work Today. New York: Prentice Hall.

c. Yukl, G., 2010, Leadership in Organizations.

BIPW 4112: ORGANIZATIONAL COMMUNICATION (KOMUNIKASI KEORGANISASIAN)

LEARNING OUTCOMES

Pada akhir mata pelajaran ini, pelajar akan dapat:

LO1 Membincangkan prinsip-prinsip asas kemahiran komunikasi organisasi untuk tujuan interaksi dalam organisasi

LO2 Memberikan maklum balas mengenai isu-isu yang berkaitan dengan pembangunan kemahiran komunikasi organisasi

LO3 Menyelesaikan masalah komunikasi organisasi berdasarkan konteks persekitaran organisasi sebenar.

SYNOPSIS

Kursus ini akan mendedahkan pelajar kepada idea-idea asas organisasi dalam komunikasi umum dan organisasi. Selain itu, pelajar juga akan dapat mengetahui teori-teori yang berkaitan dengan komunikasi organisasi dan memahami elemen-elemen penting dalam organisasi seperti kepimpinan, komunikasi rasmi dan komunikasi tidak rasmi. Selain itu, pelajar akan menyedari halangan, penyelesaian masalah dan

membuat keputusan kemahiran dalam komunikasi organisasi. Akhirnya, pelajar akan mempunyai pemahaman iklim organisasi, hubungan teknologi dan organisasi dan komunikasi korporat dalam organisasi

REFERENCES

a. Miller, K. (2012). *Organizational Communication. (4rd. ed)*. Belmont: Thomson Wadsworth Publishing Company.
b. Dennis K. Mumby (2018). *Organizational Communication: A Critical Approach. (2nd ed)*. SAGE Publications, Incorporated

BIPW 1142: PHILOSOPHY OF SCIENCE AND TECHNOLOGY (FALSAFAH SAINS DAN TEKNOLOGI)

LEARNING OUTCOMES

Pada akhir mata pelajaran ini, pelajar akan dapat:

LO1 Menghuraikan konsep ilmu, falsafah sains dan teknologi dalam perspektif Islam secara kritis dan kreatif.

LO2 Menunjukkan perkaitan antara konsep falsafah sains dan teknologi dari perspektif Islam dan barat.

LO3 Mengaplikasikan pemahaman tentang konsep ilmu falsafah sains dan teknologi dalam kehidupan masyarakat masa kin

SYNOPSIS

Kursus ini membincangkan tentang konsep ilmu, konsep falsafah, sains dan teknologi yang berunsurkan kreativiti dan inovasi menurut sarjana Islam dan barat. Selain itu, kursus ini juga menekankan tentang metodologi dalam sains Islam, konsep dan pencapaian tamadun Islam dalam bidang matematik, astronomi, fizik, kimia, perubatan, konsep penciptaan alam dan kosmologi dalam Islam, pencapaian dalam bidang telekomunikasi terkini dan isu-isu sains semasa. Pendekatan sarjana Islam silam menjadi contoh kepada generasi masa kini menjadi manusia yang kreatif dan mempunyai pemikiran kritis dalam pelbagai bidang seperti penciptaan dan kejuruteraan

REFERENCES

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BIPW 2142: INDUSTRIAL SOCIOLOGY (SOSIOLOGI INDUSTRI)

LEARNING OUTCOMES

Pada akhir mata pelajaran ini, pelajar akan dapat:

LO1 Menerangkan proses transformasi sosial masyarakat dan industri negara.

LO2 Mengenal pasti terhadap peranan dan tanggungjawab dalam pemantapan hubungan industri.

LO3 Menghubung kait dasar sosial dengan matlamat pembangunan kelestarian (SDGs).

SYNOPSIS

Kursus ini membincangkan tentang proses pembangunan sosial dan industri dalam agenda pembangunan di Malaysia. Pelajar akan didedahkan tentang teori dan model berkaitan perindustrian, strategi, dan impak pembangunan kepada ekonomi dan masyarakat. Kursus ini juga menekankan konsep dan amalan dalam hubungan industri, pasaran dan Akta Buruh, Kesatuan Sekerja dan Matlamat Pembangunan Kelestarian (SDGs). Kesedaran aspek sosiologi industri ini penting bagi memastikan Malaysia mampu menghadapi cabaran globalisasi, IR 4.0 dan era ekonomi digital untuk mengekalkan kelangsungan dan daya saing negara.

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5 ACADEMIC SYSTEM GUIDELINE

5.1 Study Period

The maximum study period in semester system is 20 normal semesters and 10 special semesters for Bachelor of Mechanical Engineering with Honours Part Time Mode.

Normal semester is the period of study of 18 weeks set by the University. Special semester is a period of study of 8 weeks conducted during the final break of the Academic Session.

5.2 Credit for Study Progress

The status of a student's academic year is based on the total Credit Earned, KD (Kredit Dapat). The formula to determine the status of academic year is as follows:

$$KD \geq JKL - 6$$

where JKL = Total Number of Regular Credits (Jumlah Kredit Lazim) decided by the faculty.

Table 5.1 shows the credit for study progress and the procedure to promote to the next academic year for Bachelor of Mechanical Engineering with Honours (BMCG).

Table 5.1 Credit for Study Progress Details for Year Promotion (BMCG)

Academic Year	Semester	Credit Load	JKL	Total KD for Year Promotion
YEAR 1	Sem. I	10	24	18 promote to YEAR 2
	Sem. 2	10		
	Special Sem.	4		
YEAR 2	Sem. 3	10	49	43 promote to YEAR 3
	Sem. 4	10		
	Special Sem.	5		
YEAR 3	Sem. 5	11	74	68 promote to YEAR 4
	Sem. 6	9		
	Special Sem.	5		
YEAR 4	Sem. 7	9	98	92 promote to YEAR 5
	Sem. 8	10		
	Special Sem.	5		
YEAR 5	Sem. 9	11	125	119 promote to YEAR 6
	Sem. 10	11		
	Special Sem.	5		
YEAR 6	Sem. 11	10	135	End of Study

5.3 Teaching and Learning

Teaching and learning (T&L) activities are conducted in Semester I, Semester II and Special Semester every year. The T&L activities are planned by Academic Management Division (BPA) on yearly basis and presented in the academic calendar. The academic calendar shows the detail of T&L activities including lectures, semester break, final examination and etc.

Teaching and learning are based on specific recognized techniques by which the knowledge is conveyed in an effective manner to the students. The programme will adopt a unique strategy for effective teaching and learning that includes the following aspects:

a. Computer-based teaching

This is based on teaching process through computer-based knowledge presentation and computer-based interactions for knowledge acquisition. The objective is to teach the students through the optimum usage of computer to help them acquire specific information on any topic of interest and develop understanding on specific knowledge in any particular course. Example of related course is Computer Programming.

b. Problem-based learning

Problem-based learning is an instructional approach that has been used successfully for over 30 years and continues to gain acceptance in multiple disciplines including mechanical engineering. It is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem. This experience will help elucidate how actual engineering problems are solved. The example of course is Mechanical Design.

c. Project-based learning

Project Based Learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an

engaging and complex engineering questions and problems. The example of course is Integrated Design Project (IDP).

d. Simulation

Simulation-based teaching is another teaching practiced by UTeM academic staff in conducting lectures, tutorials and laboratory sessions. This technique aims at supporting the tutorials and laboratory sessions by facilitating a better understanding on the course materials. It consolidates the learning process of the course. Simulation is more relevant to the physical modelling of the problems in certain domains such as those involving dangerous, intricate or expensive processes. Examples of courses using this technique are Computer Aided Design and Manufacturing, Mechanism Design and Vehicle System Modelling & Simulation.

e. Industrial application software

In addition to the normal educational software, specific industry application software, are also used for teaching and learning activities. Lecturers and tutors apply industry-based software packages in their respective courses to expose students to the use of industry-related tools. The industry-based and academic-based teaching and learning tools are combined for the purpose of enriching students' technical competencies in the courses studied. The examples of the related softwares are Solidworks, AutoCAD, ANSYS, ABAQUS and MATLAB & SIMULINK.

f. Industrial exposure

Industrial exposure is also given to students. Arrangement is made to enable students of the department to have visit to various relevant manufacturing and engineering companies. These educational visits give the opportunity to students to have some ideas of how engineering knowledge is applied in the industries. Apart of that, there are several technical talks organized by the faculty. The speakers that are invited have vast experience in the industry.

g. Projects

It is a learning technique based on conducting specific activities in order to find out the solution of a problem under consideration. This learning process may involve

theoretical, experimental, simulation, industrial exposure, industrial application software and any other teaching and learning techniques practiced. Conducting a project is one of the ways to solve an outstanding problem. It is therefore one of the more effective teaching and learning techniques adopted by UTeM. Final Year Project (*Projek Sarjana Muda*) is the best example of this method. Projects allows students to apply the basic engineering problem solving skills, which they have learned before.

h. Online learning

As a move towards digitalized learning, online learning is also introduced. In this strategy, the students have the flexibility to study learning materials through the internet with constant monitoring from lecturers. The official learning platform in UTeM is ULearn which can be accessed through https://ulearn.utem.edu.my.

i. Tutorials

Tutorials are carried out regularly to provide continuous exercise/practice to enhance students' understanding after lecture on each chapter had been completed. In addition to lectures and other activities, tutorial adds up to the required student learning time.

5.4 Assessment

The assessment on learning outcomes in semester system is performed continuously based on the students' works during the lecture weeks in a semester. Students are expected to be ready for any kind of assessment being held during the semester. The methods for assessment are through coursework and final semester examination. The final examination is comprehensive in the sense that it covers the entire syllabus of a course learned in the semester. The coursework assessment is a continuous process carried out to evaluate student's performance throughout the semester. Coursework encompasses, among others, Problem Based Learning (PBL), quiz, mid semester examination, assignment, practical work, project, case studies, industrial visit etc.

5.4.1 Coursework

Coursework is assessed by not more than 40% for degree programme. Normally the coursework is categorized as:

a. Mid Semester Test

Mid semester test is conducted to find out what the students have learned during the first half of the semester. The format of the test may be in form of multiple choice questions, calculation or open-ended questions. The processes of conducting the mid semester test is similar to the final examination procedures. The marks allocated for this test is 20% to 30% of the overall marks. Generally, the duration of the test is from 1 hour to 1.5 hours. The tentative date of the test will be announced in the teaching plan which is distributed during the first lecture.

b. Quizzes

Quizzes consist of short questions, objective questions, questions with "fill in the blanks" techniques or simple question/calculations which are designed to evaluate students' understanding during the lecture. Time allocated is approximately 15 minutes.

c. Projects

Project or assignment is an efficient way to strengthen the understanding of students for a particular course. It also provides research skill to the students. Project involves activities, such as literature survey, methodology and some design stages. The project generally requires the students to apply the theory in the real engineering field. At the end of the project, students must submit a project report and present the project.

d. Assignments / Lab Report

Assignments or Lab Report are for training individual students for using references and research works and able to present their works in an academic report form. It is also formulated for training the students in solving problems related to the topic

given and hence updating students' lecture notes. Coursework could be given to the students in several forms:

i. Design, essay forms or report on specific topic;
ii. Research works through references, computer software and programming for problem solving.
iii. Technical report i.e. formal report for experiment/practical works.

The laboratory works are either in the form of prescriptive work (diploma) or open-ended (bachelor).

Other kinds of assessments on coursework can also be considered upon faculty approval.

5.4.2 Final Examination

The Final Examination is held for two weeks at the end of the semester. It is the final evaluation on courses as set by the Faculty. For bachelor's degree programme, the weightage of the Final Examination shall be no less than 60%. The duration of the Final Examination depends on the credit hours of the course.

5.4.2.1 Conditions for Final Examination

Students are expected to attend all lectures being held in the semester. The student whose attendance is less than 80% from the total lecture hours of any course may be barred from sitting for the final examination. This regulation can be referred to the Guidelines for the Academic Regulation System, UTeM.

5.4.2.2 Special Examination

Students are allowed to request for a Special Examination of a course subject to approval of the Senate. The Lifelong Learning Center (PPSH) will send an official letter to the faculty to offer and run the special examination to the affected students. The special examination for Semester I shall be no later than 2 weeks after Semester II begins. For the semester II,

the special examination should be held no later than 3 weeks after the Semester II examination's result is released.

Special examination is carried out during the semester break for the student with medical reason and for the final semester student based on the following cases:

a. Medical Reason
   i. Student who is unable to sit for the Final Examination after being issued a Medical Certificate by the University Medical Officer or a Government Hospital/ Clinic, must submit the Medical Certificate to the Faculty within 24 hours after the start of the Final Examination of a course, unless there is a reason acceptable to the University. If the Medical Certificate is from a Private Hospital/ Clinic, it must be verified by the University Medical Officer or a Government Hospital/ Clinic.
   ii. The student's result states Incomplete (TS) until the results of the Special Examination is announced.
   iii. Special Examination results will be counted in the calculation of the Credit Earned and Credit Counted in determining the GPA, CGPA and Academic Standing.

b. Cases of the Final Semester Student
   i. Final semester student who has passed with Good Academic Standing (KB) but has failed one repeated course with the condition that the student has repeated the same course everytime it was offered.
   ii. The Special Examination results shall be stated in the examination result's transcript as "Special Examination Passed (LPK)" with HL grade for those who passed or "Special Examination Failed (GPK)" with HG grade for those who failed the course. If the student passes, the course credit will be counted as Credit Earned but not counted in the calculation of the GPA and CGPA. The original coursework marks shall not be considered.
   iii. If the student fails, the candidate will have to repeat the course in the next semester when offered and the student will have to register as full-time student as long as he/she has not utilized the maximum duration of study.
   iv. The Faculty has the authority to register the student as Special Student. It is not compulsory for the student to attend any teaching and learning activities.

The assessment will be based on previous semester's coursework marks and final examination marks of the current semester.

v. Special examination is not applicable for course that is assessed by 100% coursework.

5.5 Grading System

Student's performance in a course is evaluated based on the grade obtained. Grading system is shown in **Table 5.2**. Generally, minimum passing grade for a course is Grade D. However, Grade D up to C- are categorised as Conditional Pass and the students are allowed to improve their grade by repeating the course only once.

Table 5.2 Grading System

Grade (Achievement)	Relations Between Marks And Grade Point Value	
	Marks Percentage	Grade Point Value
A (Distinction)	80 – 100	4.0
A- (Distinction)	75 – 79	3.7
B+ (Credit)	70 – 74	3.3
B (Credit)	65 – 69	3.0
B- (Pass)	60 – 64	2.7
C+ (Pass)	55 – 59	2.3
C (Pass)	50 – 54	2.0
C- (Conditional pass)	47 – 49	1.7
D+ (Conditional pass)	44 – 46	1.3
D (Conditional pass)	40 – 43	1.0
E (Fail)	0 – 39	0.0

The status for each course is summarized in **Table 5.3**.

Table 5.3 Course Status

Grade/ Status Acronym	Explanations
HW = Compulsory Attendance Courses (*Matapelajaran Hadir Wajib*)	HW status is given to the course that the credit is not counted in the GPA and CGPA calculations but counted for KD. For this course, the results are graded as Attendance Pass, HL (*Hadir Lulus*) or Attendance Fail, HG (*Hadir Gagal*)
UM = Repeat Course (*Ulang Matapelajaran*)	UM status is given to the course that is repeated by the students who failed in that course previously. The credits for UM will not be counted for CGPA calculations.
HWUM = Compulsory Attendance Repeat Course (*Hadir Wajib Ulang Matapelajaran*)	HWUM status is given to the Compulsory Attend course for students who previously failed the course.
UG = Repeat Grade (*Ulang Gred*)	UG status is given to the repeated course for students who want to improve their grade.
TM = Redeem Course (*Tebus Matapelajaran*)	TM status is given to the course for repeating student who holds Conditional Academic Standing (KS).

The academic standing for each student is determined by the examination results obtained at the end of every semester. The status is shown in **Table 5.4**.

Table 5.4 Academic Standing

Grade/Status Acronym	Explanations
KB = Good Academic Standing (*Kedudukan Baik*)	Students with CGPA ≥ 2.00
KS = Conditional Academic Standing (*Kedudukan Bersyarat*)	Students with CGPA 1.70 ≤ CGPA < 2.00
KG = Failed Academic Standing (*Kedudukan Gagal*)	Students with CGPA < 1.70, or students with KS three times consecutively
TD = Course Withdrawal (*Tarik Diri*)	Students withdrew from any registered course except for University Compulsory course
TS = Incomplete (*Tidak Selesai*)	Students unable to sit an examination due to illness certified by Medical Officer
KBA = Good Academic Standing Award (*Kedudukan Baik Anugerah*)	Students passed all the required courses and obtained KB.
KBTT = Elapsed Good Academic Standing *(Kedudukan Baik Tamat Tempoh)*	Students utilized maximum duration of study but do not pass all the required courses as well as do not achieve KB in final semester.

5.6 Credit Transfer

Student can apply for credit transfer if they pass the same or equivalent course or possess experiences recognized by the faculty. Credit transfer can be granted to the student who had passed with minimum grade of C according to the University grading system. The application for credit transfer must be done within 2 weeks after the beginning of the first semester. The policy is as follows:

a. Credit transfer is a total credit that has been approved to the student based on certain courses taken by him/her at any other Institution of Higher Learning (IHL) either local or overseas. All the courses taken must be recognized by the university as equivalent and fulfil the curriculum of the chosen programme.

b. Credit transfer can be granted to the student that has taken the similar course and pass according to the UTeM grading system provided that the course content is 80% equivalent.

c. Educational level permitted for credit transfer must be equivalent with UTeM educational programme curriculum in terms of academic load and credit hours calculation.

d. With University's permission, students are allowed to take course in other IHL and can apply for credit transfer for those courses. The approved credit transfer will be accounted into their GPA and CGPA calculations.

e. Students are not allowed to complete their final semester study in other IHL.

f. The approval of credit transfer application will be announced to the students by the Lifelong Learning Center (PPSH). Granted credit transfer courses are recorded in the Lifelong Learning System (SPSH).

NOTE:

Any conflict in the interpretation of the above mentioned policy must be referred to The Academic Rules and Regulations for the Bachelor Degree Programme.

5.7 Credit Exemption

Credit exemption can be granted to the student who has taken similar and equivalent course and passed with respect to UTeM grading system. Application for credit exemption must be done within two (2) weeks after the beginning of the first semester.

a. Provision for the Credit exemption is outlined in the The Academic Rules and Regulations for the bachelor's degree programme to shorten the duration of study.
b. Credit exemption is a total credit that has been exempted for degree award that is granted based on the diploma qualification or equivalent experience that is recognised by the University.
c. The maximum credit exemption allowed must not exceed 30% of the overall credit required for a programme.
d. The application for credit exemption must be submitted to FKM within the first two (2) weeks of the first semester.
e. Credit exemption can be granted to student who has taken the same course or equivalent and passed with the minimum grade of C according to the university grading system with the condition that the course contents is 80% equivalent.
f. Educational level permitted for credit exemption must be equivalent to the UTeM educational programme curriculum in terms of academic load and credit hours calculation.
g. A transfer student from other IHL either local or overseas is eligible to apply for credit exemption. Upon submission, FKM will determine the courses that can be exempted.
h. For the award of degree, the total credit gain needed for credit exempted-students is the difference between the overall credit and the exempted credit.
i. The approval of credit exemption application will be announced to the students by the PPSH. Granted credit transfer courses are recorded in the SPSH.
j. The combination of credit exemption and credit transfer must **not exceed 30%** of the total credit stipulated for the award of the degree programme.

5.8 Grade Point Average

GPA (Grade Point Average) is an average grade point values earned by a student in a semester. It is calculated as below:

Total Grade Point Value / *Jumlah Mata Nilai, (JMN)* = $k_1 m_1 + k_2 m_2 + \ldots\ldots + k_n m_n$

Total Credit Counted / *Jumlah Kredit Kira, (JKK)* = $k_1 + k_2 + \ldots\ldots + k_n$

$$GPA = \frac{JMN}{JKK}$$

$$= \frac{k_1 m_1 + k_2 m_2 + \ldots + k_n m_n}{k_1 + k_2 + \ldots + k_n}$$

where

k_n = Credit for n^{th} course.

m_n = Grade point value earned for n^{th} course.

Example 1 GPA Calculation

BMCG YEAR 1 (SEMESTER I)

CODE	COURSE	GR	MN	KR	JMN	ST
BLLW 1142	ENGLISH FOR ACADEMIC PURPOSE	A	4.0	2	8.0	
BIPW 1132	PHILOSOPHY AND CURRENT ISSUES	B+	3.3	2	6.6	
BMFG 1313	ENGINEERING MATHEMATICS I	C	2.0	3	6.0	
BMFG 1213	ENGINEERING MATERIALS	A	4.0	3	12.0	
	TOTAL			**10**	**32.6**	

	CURRENT SEMESTER	ALL SEMESTER
KD	10	10
KP		0
KK	10	10
JMN	32.6	32.6
GPA	3.26	
CGPA		3.26
FINAL RESULT		
Good Academic Standing (KB)		

GPA for Semester 1

Total Grade Point Value (JMN) = 32.6
Total Credit Counted (JKK) = 10
GPA = 32.6 / 10 = 3.26

5.9 Cumulative Grade Point Average

CGPA (Cumulative Grade Point Average) is an average grade point earned by a student through out all semesters undertaken. It is calculated as below:

$$CGPA = \frac{(JMN)_1 + (JMN)_2 + ... + (JMN)_n}{(JKK)_1 + (JKK)_2 + ... + (JKK)_n}$$

where

$(JMN)_n$ = Total grade point value earned in n^{th} semester.
$(JKK)_n$ = Total credit counted in n^{th} semester.

Example 2 CGPA Calculation

BMCG YEAR 1 (SEMESTER 2)

CODE	COURSE	GR	MN	KR	JMN	ST
BKKX XXX1	CO-CURRICULUM I	B+	3.3	1	3.30	
BMCG 1013	DIFFERENTIAL EQUATIONS	B	3.0	3	9.00	
BEKG 1233	PRINCIPLES OF MEASUREMENT AND INSTRUMENTATION	C-	1.7	3	5.10	
BMCG 1113	STATICS	A	4.0	3	12.00	
	TOTAL			**10**	**29.40**	

	CURRENT SEMESTER	ALL SEMESTER
KD	10	20
KP		0
KK	10	20
JMN	29.40	62.0
GPA	2.94	
CGPA		3.10
FINAL RESULT		
Good Academic Standing (KB)		

*Continuation from Example 1

GPA for Semester 2

Total Grade Point Value (JMN) = 29.40
Total Credit Counted (JKK) = 10
GPA = 29.40 / 10 = 2.94

CGPA for all semesters (1 and 2)

Total Grade Point Value (JMN) = 32.6 + 29.4 = 62.0
Total Credit Counted (JKK) = 10 + 10 = 20
CGPA = 62.0 / 20 = 3.10

Example 3 CGPA Calculation

BMCG YEAR 1 (SPECIAL SEMESTER)

CODE	COURSE	GR	MN	KR	JMN	ST
BMCG 1523	ENGINEERING GRAPHICS AND CAD	B+	3.3	3	9.90	
BMCG 2021	MECHANICAL ENGINEERING WORKSHOP	B	3.0	1	3.00	
	TOTAL			**4**	**12.90**	

	CURRENT SEMESTER	ALL SEMESTER
KD	4	24
KP		0
KK	4	24
JMN	12.90	74.90
GPA	3.22	
CGPA		3.12
FINAL RESULT		
Good Academic Standing (KB)		

*Continuation from Example 1 and 2

GPA for Year 1 Special Semester

Total Grade Point Value (JMN) = 12.90
Total Credit Counted (JKK) = 4
GPA = 12.90 / 4 = 3.22

CGPA for all semesters (1, 2 and Special)

Total Grade Point Value (JMN) = 32.6 + 29.4 + 12.90 = 74.90
Total Credit Counted (JKK) = 10 + 10 + 4 = 24
CGPA = 74.90 / 24 = 3.12

5.10 Course Withdrawal

The students are entitled to Course Withdrawal (TD) from any course if they feel that their performance is poor. T**he last date for course withdrawal is in week thirteen (13) for the normal semester and in week six (6) for the special semester.** The students are allowed to sit or repeat the course if it is offered by the faculty. With the verification from the Academic Advisor, students can withdraw any registered course provided that the minimum load of 6 credit hours remains for normal semester, while minimum 2 credit hours for special semester.

If the credit hour taken is less than 6 credits for normal semester and 2 credit for special semester. and the student decided to withdraw any course, the Faculty's Dean approval is required.

The normal guideline for course withdrawal is as follows:

a. Course withdrawal is allowed within the period regulated by the University. Withdrawal is not encouraged as it reflects the student's weaknesses in planning for course enrolment and failure to follow the projected credit hours. The Course Withdrawal (TD) status will be printed in the programme registration slip and final transcript.
b. The student is not allowed to withdraw any co-curriculum course.

c. The students are required to re-register for the course that they had withdrawn, except the elective course which can be substituted with other elective courses.
d. Any tuition fees paid (if relevant) prior to withdrawal, will not be refunded.

Below are examples of student who wants either to withdraw or continue taking any particular course during the same semester as shown in Examples 5 and 6.

Students who withdraw the course (i.e. BMCG 2113) will be exempted from taking the final examination and the credit hour for that course will not be considered in the GPA calculation for that particular semester.

Example 4 Course Withdrawal GPA Calculation

BMCG YEAR 2 (SEMESTER 3)

CODE	COURSE	GR	MN	KR	JMN	ST
BIPW 2132	APPRECIATION OF ETHICS AND CIVILIZATION	A-	3.7	2	7.4	
BEKG 1123	PRINCIPLES OF ELECTRIC AND ELETRONICS	C	2.0	3	6.0	
BMCG 1213	DYNAMICS	TD	-	-	-	
BMCG 2312	MANUFACTURING PROCESS	B	3.0	2	6.0	
	TOTAL			***7***	**19.40**	

	CURRENT SEMESTER	ALL SEMESTER
KD	*7*	31
KP		0
KK	*7*	31
JMN	19.4	94.30
GPA	2.77	
CGPA		3.04
FINAL RESULTS		
Good Academic Standing (KB)		

*Continuation from Example 3

GPA for Semester 3

Total Grade Point Value (JMN) = 19.40
Total Credit Counted (JKK) = *7*
GPA = 19.4 / *7* = 2.77

CGPA for all semesters (1, 2, Year 1 Special and 3)

Total Grade Point Value (JMN) = 32.60 + 29.40 + 12.90 + 19.40 = 94.30
Total Credit Counted (JKK) = (10 + 10 + 4) + *7* = 31
CGPA = 94.30 / 31 = 3.04

Example 5 GPA Calculation if the Student Continue Taking the Course (No Withdrawal)

For student who decided NOT to withdraw the course (i.e BMCG 1213) then the credit hours for that course will be counted for the GPA calculation for Semester 3.

BMCG YEAR 2 (SEMESTER 3)

CODE	COURSE	GR	MN	KR	JMN	ST
BIPW 2132	APPRECIATION OF ETHICS AND CIVILIZATION	A-	3.7	2	7.4	
BEKG 1123	PRINCIPLES OF ELECTRIC AND ELETRONICS	C	2.0	3	6.0	
BMCG 1213	DYNAMICS	E	0.00	3	0.0	
BMCG 2312	MANUFACTURING PROCESS	B	3.00	2	6.0	
	TOTAL			**10**	**19.4**	

	CURRENT SEMESTER	ALL SEMESTER
KD	7	31
KP		0
KK	10	34
JMN	19.4	94.30
GPA	1.94	
CGPA		2.77
FINAL RESULTS		
Good Academic Standing (KB)		

*Continuation from Example 3

GPA for Semester 3)

Total Grade Point Value (JMN) = 19.4
Total Credit Counted (JKK) = 10
GPA = 19.4 / 10 = 1.94

CGPA for all semesters (1, 2, Year 1 Special, 3 and 4)

Total Grade Point Value (JMN) = 32.60 + 29.40 + 12.90 + 19.40 = 94.30
Total Credit Counted (JKK) = (10 + 10 + 4) + 10 = 34
CGPA = 94.30 / 34 = 2.77

Examples 4 and 5 have shown that the student's results are affected when the student decides to either withdraw (TD) or continue taking the course. In Example 5, the student's GPA will be drastically dropped to 1.94 as compared to 2.77 in Example 4. The withdrawal will also affect the CGPA from 3.04 to 2.77. Therefore, the student has to consider carefully when deciding whether or not to withdraw.

5.11 Course Repeating

Students are allowed to repeat any failed course if the course is offered by the faculty. The repeating grade will be the official grade in the transcript if it is higher than the previous one, otherwise the previous grade prevails.

Referring to Example 5, assuming that the student wants to resit for BMCG 1213, CGPA calculation is shown as below:

Example 6 CGPA Calculation for Resitting

BMCG YEAR 2 (SEMESTER 4)

CODE	COURSE	GR	MN	KR	JMN	ST
BKKX XXX1	CO-CURRICULUM II	B+	1	3.3	3.3	
BITG 1233	COMPUTER PROGRAMMING	B-	3	2.7	8.1	
BEKG 2433	ELECTRICAL SYSTEMS	B+	3	3.3	9.9	
BMCG 2513	COMPUTER AIDED DESIGN AND MANUFACTURING	B+	3	3.3	9.9	
BMCG 1213	DYNAMICS	C+	3	2.3	6.9	UM
	TOTAL		**13**		**38.1**	

	CURRENT SEMESTER	ALL SEMESTER
KD	13	44
KP		0
KK	13	44
JMN	38.1	132.4
GPA	2.93	
CGPA		3.01
FINAL RESULTS		
Good Academic Standing (KB)		

*Continuation from Example 5

GPA for Semester 4

Total Grade Point Value (JMN) = 38.1
Total Credit Counted (JKK) = 13
GPA = 38.1 / 13 = 2.93

CGPA for all semesters (1,2 , Year 1 Special, 3 and 4)

Total Grade Point Value (JMN) = 32.6 + 29.40 + 12.90 + 19.4 + 38.1 = 132.4
Total Credit Counted (JKK) = 10 + 10 + 4 + 10 + 13 - 3 = 44
CGPA = 132.4 / 44 = 3.01

For CGPA calculation, the course BMCG 1213 is a repeat course (from Semester 3 and the previous grade obtained is E). The previous grade and credit (3) should be discarded for the CGPA calculation in Semester 4.

5.12 Failed Academic Standing (KG)

Example 7 Failed Academic Standing (KG) - Dismissal

BMCG YEAR 1 (SEMESTER 1)

CODE	COURSE	GR	MN	KR	JMN	ST
BLLW 1142	ENGLISH FOR ACADEMIC PURPOSE	C-	1.7	2	3.4	
BIPW 1132	PHILOSOPHY AND CURRENT ISSUES	C-	1.7	2	3.4	
BMFG 1313	ENGINEERING MATHEMATICS I	D+	1.3	3	3.9	
BMFG 1213	ENGINEERING MATERIALS	D	1.0	3	3.0	
	TOTAL			**10**	**13.7**	

	CURRENT SEMESTER	ALL SEMESTER
KD	10	10
KP		0
KK	10	10
JMN	13.7	13.7
GPA	1.37	
CGPA		1.37
FINAL RESULTS		
Failed Academic Standing (KG)-Dismissal		

GPA for Semester 1

Total Grade Point Value (JMN) = 13.7
Total Credit Counted (JKK) = 10
GPA = 13.7 / 10 = 1.37

In Example 7, the GPA and CGPA of the student is 1.37. Even if the student passed all the courses with a minimum of D grade, the student will still be dismissed since CGPA is less than 1.70.

5.13 Conditional Academic Standing (KS)

Example 8 Conditional Academic Standing (KS)

BMCG YEAR 1 (SEMESTER 1)

CODE	COURSE	GR	MN	KR	JMN	ST
BLLW 1142	ENGLISH FOR ACADEMIC PURPOSE	C-	1.7	2	3.4	
BIPW 1132	PHILOSOPHY AND CURRENT ISSUES	C	2.0	2	4.0	
BMFG 1313	ENGINEERING MATHEMATICS I	C	2.0	3	6.0	
BMFG 1213	ENGINEERING MATERIALS	D+	1.3	3	3.9	
	TOTAL			**10**	**17.3**	

	CURRENT SEMESTER	ALL SEMESTER
KD	10	10
KP		0
KK	10	10
JMN	17.3	17.3
GPA	1.73	
CGPA		1.73
FINAL RESULTS		
Conditional Academic Standing (KS)		

GPA for Semester 1

Total Grade Point Value (JMN) = 17.3
Total Credit Counted (JKK) = 10
GPA = 17.3 / 10 = 1.73

Conditional Academic Standing is the result for students who gets CGPA below 2.00 but not in KG status ($1.70 \leq CGPA < 2.00$). The student is allowed to continue the study with a maximum of 6 credit hours for the following semester until the student achieve Good Academic Standing (KB).

Normally the sponsors have the right to suspend the financial support for the students until they improve their study by getting CGPA > 2.0. If the Conditional Academic Standing (KS) is repeated 3 times consecutively, then the candidate will be dismissed.

5.14 Good Academic Standing (KB)

Example 9 Good Academic Standing (KB)

BMCG YEAR 1 (SEMESTER 1)

CODE	COURSE	GR	MN	KR	JMN	ST
BLLW 1142	ENGLISH FOR ACADEMIC PURPOSE	E	0.0	2	0.0	
BIPW 1132	PHILOSOPHY AND CURRENT ISSUES	B+	3.3	2	6.6	
BMFG 1313	ENGINEERING MATHEMATICS I	B+	2.0	3	6.0	
BMFG 1213	ENGINEERING MATERIALS	A-	4.0	3	12.0	
	TOTAL			**10**	**24.6**	

	CURRENT SEMESTER	ALL SEMESTER
KD	8	8
KP		0
KK	10	10
JMN	24.6	24.6
GPA	2.46	
CGPA		2.46
FINAL RESULTS		
Good Academic Standing (KB)		

GPA for Semester 1

Total grade points (JMN) = 24.6
Total calculated credit (JKK) = 10
GPA = 24.6 / 10 = 2.46

This student passed 3 (KD = 8) out of 4 courses (KK = 10) taken. The student obtained KB with GPA = 2.46.

But he/she failed in the BLLW 1142 English for Academic Purpose course, which is the pre-requisite for BLLW 2152 Academic Writing. The student **MUST RESIT** the BLLW 1142 English for Academic Purpose course until he/she get at least a minimum of D grade in order to take BLLW 2152 Academic Writing course. The student may be expected to extend his/her duration of study, depending on the total credit hours required to graduate.

5.15 Graduation Requirements and Class

Students deserve to be awarded with certificate upon satisfying the following requirements:

a. Student must obtain a Good Academic Standing (KB) in the final semester.

b. Student has passed all courses required by the programme and obtained Good Academic Standing Award (KBA). Please refer to **Table 5.5** for total credit numbers based on course categories for KBA.

Table 5.5 Credit number for Graduation status

Course Category	UNIVERSITY COMPULSORY	COMMON CORE COURSE	PROGRAMME CORE COURSE	ELECTIVE	TOTAL
BMCG	18	53	52	12*	**135**

* 12 credits for Programme Elective, 2 for Language Elective and 2 for General / Open Elective (BMCG)

c. Student has applied for graduation status, approved by faculty and endorsed by University Senate.

d. Student has passed MUET and obtain band specified by the University.

e. Student has fulfilled other requirements as specified by the University.

The award of certificate will be classified according to the graduation class given in **Table 5.6.** However, the graduation class is not stated in academic transcript.

Table 5.6 Graduation Class

Class	Explanations
First Class with Honours	Students with CGPA ≥ 3.70
Second Class (Upper) with Honours	Students with CGPA 3.00 ≤ CGPA < 3.69
Second Class (Lower) with Honours	Students with CGPA 2.00 ≤ CGPA < 2.99

6 ACADEMIC ADVISORY SYSTEM

6.1 Introduction

The Academic Advisory System is established for the purpose of providing comprehensive advice in terms of education, teaching and assessment for students during their studies in UTeM. The Academic Advisor (Penasihat Akademik or PA) roles for part time students are carried by the appointed Academic Coordinators according to students' registration groups.

6.2 Academic Advisory Objectives

Students in university have life that is totally different from the school environment. Being away from family, relatives and old friends, students are required to have good self motivation in order to survive and succeed in their studies. The students are also expected to gain information and to adapt quickly with the change of rules in a campus life.

Students should therefore utilize the existence of the Academic Advisory System that can help them in their academic achievement. Academic staffs shall be regarded as a friend or mentor to seek for advice and opinion.

The objectives of Academic Advisory System are:

a. To provide a proper channel for students to obtain an advice and counselling especially on academic problem.
b. To establish two ways of communications between students and faculty/university.
c. For the advisor to recognize the students' ability and capability.
d. To produce a discipline and balance attitude of students.
e. As a platform for sharing opinion, information and giving advice on the overall aspects of the student's life in university.

6.3 Academic Advisory Structure

The faculty has set the Academic Advisory System as one of the platforms to obtain feedback from students. This is important for the continuous improvement based on the positive as well as demanding feedback received from the students. The procedures of the Academic Advisory System are shown in **Figure 6.1**.

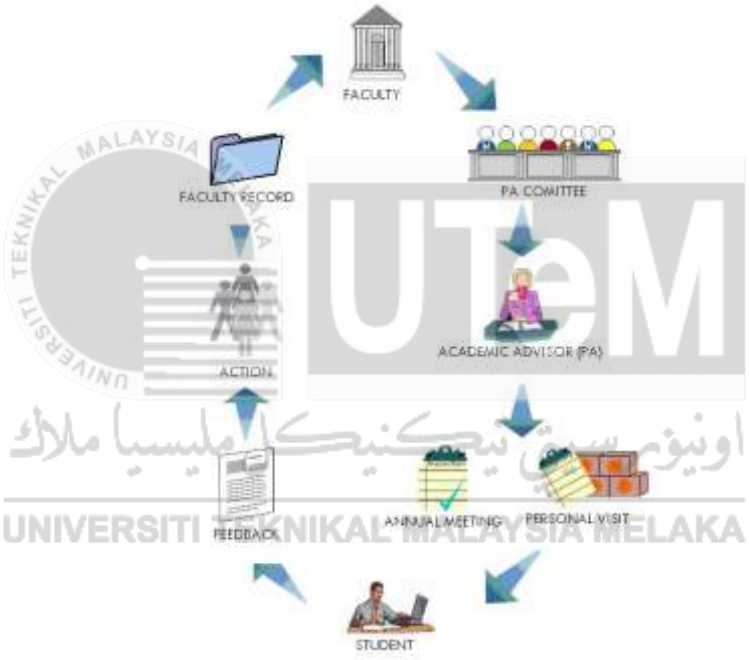


Figure 6.1 Academic Advisory System

There are two important components in the system. First is the meeting with the students to seek for feedback, and second, is for the academics to give advice and to take action related to the student's academic problem appropriately. Student's feedback can be

gathered from annual meeting and/or personal meeting. All records such as student's personal and academic information are updated during the meeting and documented in the faculty.

The Academic Advisory System working procedure is as follows:

a. Students will be divided into several groups consisting of 30 to 40 students. Each group is led by one Academic Advisor (Penasihat Akademik or PA). The PA for part time students is an experienced academic staff who is appointed as the Academic Coordinator for students' registration group.
b. PA will remain with the students until they graduate. PA shall be regarded as a mentor for the students.
c. PA keeps and updates the students' records under his/her group. These records include academic performances of the students until they graduate. The records also include feedback, application letters as well as issues relating to academic and non-academic. These records are kept by the PA for future reference.

6.4 Student's Academic Advisory Mechanism

The appointed academic staff should be aware of the objectives of the Academic Advisory System. Formal and informal meeting sessions are important. Students shall be responsive to the faculty's intention to help them through the following mechanism:

a. Students can meet their PA at their own initiative. More informal meetings are encouraged.
b. Formal meeting between students and PA is made by appointment or any other methods agreed.
c. Detail of the discussion is recorded for future reference.
d. Attendance is compulsory for the meeting organized by their PA.

6.5 Academic Advisor's Responsibility

PA has the responsibility to help students with poor academic achievement. Normally, good students are more approachable whilst poor students are difficult to engage for

discussion and meeting. From the beginning the students must be aware that academic progress and achievement are their responsibility.

The faculty has outlined the role of PA are as follows:

a. Play an important role in giving advice, guidance and motivation to students regarding their academic and non-academic matters.
b. Monitor student's academic development, progress and performance.
c. Schedule meeting which is agreed by both parties.
d. Assist students in understanding the organization structure, method and procedure of university's administration.
e. Refer to professional counsellor in order to solve student problem, when necessary.
f. Encourage students to be involved in academic and non-academic activities organized by the university.

6.6 Student Responsibility

In the university, students are fully responsible on their achievement in their studies. The student's responsibilities are as follows:

a. Consistently meet their PA to seek for advice in solving academic and non-academic problems.
b. Discuss the study plan every semester before registering new courses for the next new semester.
c. Discuss with the PA to plan for future meeting schedule and must commit to their plan.
d. Meet the PA during free time to discuss any issue arises related to education, general knowledge, technology development and career.
e. Consider any advice given and act appropriately.
f. Regard the PA as a good friend to open-up for discussion.

6.7 Learning Guidance In University

The learning environment in university differs greatly to that in school. Students must therefore adapt to the new learning method accordingly, where most of the time, students are expected to have self motivation and self independence to learn the materials giving in the class by the lectures. Several measures on how to succeed in the university are pointed out as follows:

a. Manage time effectively. Students should participate in positive activities and stay away from being involved in any illegal activities.
b. Plan out properly for the courses to be registered for each semester by consulting the PA.
c. Choose co-curriculum and elective courses that are suitable according to own capability and interest, subjected to some faculty's arrangement.
d. Well disciplined in attending lectures, tutorials, and lab sessions.
e. Motivated and highly aspired throughout the studies in university to ensure good performance in quizzes, assignments, laboratory works, tests and final exam.
f. Avoid last-minute studying. Revision should be done on a regular basis.

7 FACILITIES AND ETHICS IN LABORATORY WORK

7.1 Overview of Facilities

The teaching and learning for part time students of Melaka groups are arranged at lecture rooms located within UTeM's campuses. The classes are arranged due to availability and feasibility, using facilities at UTeM's Main Campus, Durian Tunggal, and FKM's Buildings at Technology Campus, Ayer Keroh. Meanwhile, teaching and learning for Perak groups of part time students are executed at MARA Skills Institution (Institusi Kemahiran MARA or IKM), Manjung, Perak. **Figure 7.1** shows the building facilities for both Melaka and Perak groups of part time students.

In general, our part time students are being privileged similar to those full time students such as eligibility to enter university's premises, library usage, book loan, cafeteria dine-in, sport equipments usage, Wi-Fi connection, health services at UTeM's Health Centre, as well as daily rental of student's in-campus accommodation. At IKM Manjung, similar teaching and learning experiences are offerred to students due to the availability of complete facilities to support university's academic courses. Some of available facilities at IKM Manjung are also shown in **Figure 7.1**.

FKM Building at Technology Campus

Other faculty at UTeM's Main Campus

IKM Manjung for Perak Groups

Lecture Hall at IKM Manjung

Library at IKM Manjung

Cafetaria at IKM Manjung

Figure 7.1 Some facilities to support teaching and learning of part time students

Being registered as part time students of FKM, the faculty welcomes the students to familiarize themselves with all the facilities available at the campus. These include lecture rooms and laboratories, located in Technology Campus, UTeM. **Table 7.1** lists the locations of facilities in the main building of FKM in Technology Campus. Besides that, all Mechanical Engineering Laboratories are also located at this Technology Campus, in some other buildings behind the main building. Faculty has developed the laboratories based on the courses offered. Through these laboratories, students will be exposed to the related machine handling experience as well as practical exposure on theory proofing learned in

the lecture hall. This is to prepare themselves to become not only a knowledgeable engineer but also highly competitive in technical aspects and applications.

Table 7.1 Locations of Facilities in FKM

No.	Name	Location	Level
1	Administration Office	FKM Main Building (Technology Campus)	4
2	Security Office		1
3	Development Office		1
4	Student Clinic		1
5	Lecture Rooms BK1-BK10		1
6	Lecture Rooms BK11-BK17		2
7	Post Graduate Area		2
8	Faculty of Mechanical Engineering Student Association (FaMESA) room		2
9	Library		3
10	Lecturer Rooms		6 & 7
11	Lecture Rooms BK1 - BK6 (KMKM)	Mechanical Engineering Laboratory Complex	1 & 2
12	Tutorial Rooms BT1 - BT10 (KMKM)		1
13	Laboratories, Workshops & Studios		1 & 2

The entire laboratory is managed by a Lab Coordinator with the help of Field Cluster Leader appointed among the academic staff. The lab management is also supported by technical support staff led by a Unit Leader. The tools, machines and equipments of each laboratory are developed by respective departments. The Lab Management Committee is responsible for the daily usage, consumables and maintenance of the labs.

7.2 Objectives of Laboratory Work and Workshop

The faculty has developed laboratory work to enhance the understanding of the theory given during the lecture. The activities have been developed for the students so that it will

not only provide better understanding of the concepts learned but also skills in handling the equipment and ability to solve the given problem. The laboratories are also utilised for research and consultation work for the public. Below are the objectives of the laboratory work:

a. To develop the interest of the students in engineering field by exposing them to the work procedure and equipment handling in solving engineering problem.
b. To relate the engineering theory by validating data obtained from the experiment.
c. To increase the tools-handling skill and understanding the concept taught during the lecture.
d. To simulate and analyse engineering problems that are based on the knowledge acquired in the lecture.
e. To build up teamwork among the students during laboratory and workshop activities.
f. To support the research activities.
g. To provide consultation work for other institutions or agencies.

7.3 Laboratory Facilities

In line with the university's aim, the development of the facilities has rapidly increased to support teaching & learning, and research activities. As the course curriculum comprises of laboratory courses, therefore the development of the laboratory shall reflect the syllabus of the course.

Most of the laboratories are equipped with state-of-the-art facilities. These facilities are used not only for teaching and learning activities, but also for research and consultation works. In line with the Engineering Accreditation Councils (EAC) requirements, the faculty managed to reduce the ratio of students to the equipments/tools down to 1:6. Besides that, the computer facilities for the students are undergoing staggered upgrading in order to achieve the ratio of 1:1 (computer: student).

The development of the FKM laboratories has been carried out progressively. **Tables 7.2** and **Table 7.3** show the list of existing laboratories for teaching and learning as well as

research in FKM. At present, 23 laboratories have been developed for teaching and learning and 21 laboratories for research activities. The laboratories, workshops and studios are located at Mechanical Engineering Laboratory Complex (F2 and F5), both within Technology Campus. Generally, each laboratory can accommodate at least 30 students at a time. Sample of laboratory facilities are shown in **Figure 7.2**.

Table 7.2 List of Laboratories for Teaching and Learning

No.	Name of Laboratory	Location
1	Computer Aided Design Studio 1	Mechanical Engineering Laboratory Complex (F5)
2	Computer Aided Design Studio 2	
3	Computer Aided Design Studio 3	
4	Computer Aided Design Studio 4	
5	Computer Aided Engineering (CAE) Studio	
6	Automotive Design Lab	
7	Thermodynamics Lab	
8	Mechanics of Machine Lab	
9	Fluid Power Lab	
10	Machine Workshop	
11	Machine Building Workshop	
12	Fitting & Fabrication Workshop	
13	IDP Workshop	
14	PSM Workshop	
15	Fluid Mechanics Lab	
16	Welding Workshop	
17	Automotive Services Lab	
18	Material Science Lab	
19	Dynamics Lab	
20	Structure Mechanics Lab	
21	Statics Lab	
22	Heat Transfer Lab	
23	Chemical Lab	Mechanical Engineering Laboratory Complex (F2)

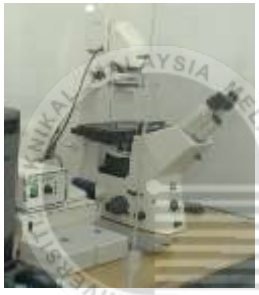
Table 7.3 List of Research Laboratories

No.	Name of Laboratory	Name of Research Group	Location
1	Green Technology Vehicle Lab	Green And Efficient Energy Technology Research Group (GrEET)	Mechanical Engineering Laboratory Complex (F5)
2	Engine Performance Testing Lab	Green And Efficient Energy Technology Research Group (GrEET)	
3	Composite & NDT Lab	Advanced Materials Research Group (A-MAT)	
4	High Performance Structure Lab	Advanced Materials Research Group (A-MAT)	
5	Autotronic Lab	Intelligent Vehicles Systems Research Group (InVeS)	
6	Energy Efficient Lab	Green And Efficient Energy Technology Research Group (GrEET)	
7	Advanced Fluid Mechanics Lab	Green And Efficient Energy Technology Research Group (GrEET)	
8	Prototype & Innovation Lab	Innovation and Sustainability In Machine Technologies Research Group (i-SMAT)	
9	Research Workshop	General	
10	Innovation Lab	Innovation and Sustainability In Machine Technologies Research Group (i-SMAT)	Mechanical Engineering Laboratory Complex (F2)
11	Vibration & Acoustic Lab	Intelligent Vehicles Systems Research Group (InVeS)	
12	Maintenance Engineering Lab	-	
13	Advanced Academia-Industry Collaboration Lab Scanning Electron Microscope Room	Advanced Materials Research Group (A-MAT)	
14	Applied Mechanical Design	Innovation and Sustainability In	

	Lab (AMD)	Machine Technologies Research Group (i-SMAT)	
15	Advanced Materials Characterization Lab (AMCHAL)	Advanced Materials Research Group (A-MAT)	
16	Condition Based Maintenance Lab	-	
17	Structural Health Monitoring Lab	-	
18	LabView Studio	-	
19	Applied Solar Energy Lab (ASEL)	Green And Efficient Energy Technology Research Group (GrEET)	
20	Tribology Lab	Green Tribology And Engine Performance Research Group (G-TriboE)	
21	Computer Studio (Research)	Innovation and Sustainability In Machine Technologies Research Group (i-SMAT)	7th Floor, FKM

SCANNING ELECTRON MICROSCOPE

TRIVECTOR WEAR DEBRIS ANALYZER



INVERTED MICROSCOPE

UNIVERSAL TESTING MACHINE

CNC LATHE MACHINE

FTIR SPECTROPHOTOMETER

Figure 7.2 Sample of Laboratory Facilities

7.4 Work Ethics

All students are bound to the University Regulation & Guideline while working in the laboratory. These guidelines are meant to provide safe working environment for the safety of equipments and building in the laboratory as well as to avoid accident.

The faculty has detailed out the regulations for working in laboratories as the working procedures is the fundamental aspect of laboratory activities. Students are required to follow these guidelines while they are in the laboratory or within the vicinity of the laboratory. The objectives of these guidelines are as follows:-

a. To create a secure, safe and conducive working environment during laboratory and practical works.
b. To guarantee the safety of the students and their environment.
c. To highly cultivate discipline culture among students.
d. To adapt professional working ethics.
e. To prolong the equipments' life span and to maintain it with proper use and procedures.
f. To prevent misuse of equipments and avoid inappropriate and unnecessary damage to the equipments.
g. To make sure the practical work session is efficient without undue interference.

The working ethics are divided into three (3) categories, namely General Work Ethics, Laboratory Work Ethics and Dress Code in the Laboratory.

7.4.1 General Work Ethics

General work ethics is inevitably important. As student and future mechanical engineer are the people who will shape the national future engineering environment, general work ethics should be emphasised no matter where they are. To uphold these basic guidelines, the following instructions are enforced:

a. No entrance into the laboratory or work with the equipments without permission of laboratory manager or authorised staff.

b. Equipments should not be taken out of the laboratory without prior permission from laboratory manager or authorised staff.
c. No food or drinks are allowed in the laboratory or workshops.
d. Non-related items are not allowed in the laboratory, such as bags and helmets.
e. Unacceptable behaviour or act will not be tolerated.
f. Obey the instructions given by the laboratory manager or authorised staff.
g. Adhere and understand the procedures in the laboratory such as laboratory submission procedures, equipment on loan procedures and the procedure of working during non-office hours.
h. Report any accident to the the laboratory manager or authorised staff immediately.
i. Keep the laboratory clean and safe after every laboratory session.
j. Place any laboratory leftover or waste materials in the respective bin.

7.4.2 Operational Work Ethics

The Laboratory Operational Work Ethics is one of the guidelines that all mechanical engineering students should adhere to during their laboratory session. This guideline is specifically focused in handling practical works in the laboratory. Among the aspects to be observed by the students are as follows:-

a. During laboratory session, students should always be supervised by at least either a laboratory instructor or a technical staff.
b. Students should obtain a copy of laboratory sheet that could be downloaded from faculty website before starting a practical works.
c. Students should understand the working procedures of equipment before commencing laboratorial activities by referring to the work manual or instruction given by the lecturer or technical staff.
d. Students should sign attendance list distributed by the technical staff in charge.
e. Students should use and optimise the time allocated to finish off their practical works including recording observations and conclusions.
f. All laboratory reports should be submitted on time. Informal report should be handed in three (3) working days after the laboratory session took place. For

formal report, it should be submitted seven (7) working days after the date of the laboratory session.

g. Laboratory reports should be submitted to the lecturer that in charge during the laboratory session.
h. For any defects found on the equipments, kindly report to the lecturer or technical staff in charge.
i. Equipments/tools must be returned to their designated location.

7.4.3 Dress Code

Dressing reflects the culture of the working environment. Irrespective of type of working environment, one must dress appropriately. The university has distributed a general guideline to the students on dress code within the university area. As far as the faculty is concerned, the dress code applies specifically for workshops or laboratories. The detail of the dress code can be referred to the Pejabat Hal Ehwal Pelajar dan Alumni. The following instruction must be carefully observed by the students while they are around or working in the laboratory.

a. Students should always display matrix cards for ease of identification.
b. Students should always wear appropriate dress corresponding to the activities undertaken.
c. Students should always wear proper personal protective equipment such as goggles, hand gloves or aprons while handling high risk equipments.
d. Students must wear covered shoes inside the laboratory. Any uncovered shoes are not allowed at all times.
e. For all activities inside the workshop, student must wear safety shoes.
f. Students are encouraged to wear workshop coat at the laboratory compound. Any collarless or round neck T-shirt is not allowed.
g. Female student with scarf should tie it at the back of her neck or tug it in her workshop coat. Loose clothing could increase possibility of accident.
h. Students are not allowed to wear any jewellery such as necklace or bracelet that will affect their safety.
i. Male students should keep their hair short. Female students with long hair should tie up their hair at the back of their head.

j. Students should always be neat and tidy.

7.5 Implementation of Laboratory Work

The purpose of laboratory work is to increase student's understanding on the course taught. Several laboratories were developed to cater the demand for the courses. In general, the conduct of the laboratory is parallel to the course registered on that particular semester.

Each laboratory subject is conducted in a period of 14 weeks which consists of 4 laboratory sessions. During the first week before the laboratory session started, student will be briefed on the content and how the laboratory will be conducted. Some of the content during the orientation (1 week) period are as follows:

a. Name of laboratory station and how the experimental work will be conducted.
b. Number and name of experimental work to be carried out.
c. Brief explanation of the laboratories work.
d. Group formation.
e. Format of report writing and marking scheme.

Each laboratory session is conducted in 3 weeks consist of activities as follows:

a. Briefing on specific experiment explained by the lecturer/the instructor
b. Students conduct the specific experiment
c. Laboratory report preparation and submission.

There are two approaches of laboratory work which are prescriptive laboratory work and open-ended laboratory work. For prescriptive laboratory activities, the students are provided with complete laboratory sheet and are fully guided by the lecturer or the instructor during the laboratory session. Prescriptive laboratory work will be conducted for diploma laboratory courses. Meanwhile, bachelor laboratory courses will implement open-ended approach. In this approach, the students will be given a very minimum guidance from the lecturer or instructor. The laboratory sheet is given for the open-ended laboratory with minimum guideline. Open ended laboratory work allows the opportunity for students to be creative about the execution, analysis and evaluation of laboratory

work. Students create, for example, the evidence, the analysis, and the evaluation of laboratory work. Often synthesis is also involved in open-ended work. These processes involve interaction while in the laboratory (in-lab work) and after leaving the laboratory (post-lab work). The students are fully responsible to conduct and handle the experiment themselves after short briefing given by the lecturer or the instructor. The students work in a group of 4 to 5 persons. They need to determine the objectives, apparatus and methods as well as how to execute the experiment. A report including results, discussion, conclusion and references is submitted for evaluation.

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