UNIVERSITI SAINS MALAYSIA

BACHELOR *of* ENGINEERING

School of ELECTRICAL AND ELECTRONIC ENGINEERING

2017/2018

www.usm.my

USM Vision

Transforming Higher Education for a Sustainable Tomorrow

USM Mission

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

STUDENT'S PERSONAL INFORMATION

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

CONTENT **PAGE**

ACADEMIC CALENDAR - ACADEMIC SESSION 2017/2018

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

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

SEM	WEEK	ACTIVITY	DATE	REMARKS
ONE	1	Teaching & Learning Period (T&LP - 5 Weeks)	Monday, 11.09.2017 - Sunday, 17.09.2017	01.09.2017, Friday - Eid-ul adha 09.09.2017, Saturday - Agong's Birthday
	2		Monday, 18.09.2017 - Sunday, 24.09.2017	16.09.2017, Saturday - Malaysia Day
	3		Monday, 25.09.2017 - Sunday, 01.10.2017	22.09.2017, Friday - Maal Hijrah 1439
	4		Monday, 02.10.2017 - Sunday, 08.10.2017	
	5		Monday, 09.10.2017 - Sunday, 15.10.2017	
	6	Mid Semester Break	Monday, 16.10.2017 - Sunday, 22.10.2017	18.10.2017, Wednesday - Deepavali**
	7	Teaching & Learning Period (T&LP - 9 Weeks)	Monday, 23.10.2017 - Sunday, 29.10.2017	
	8		Monday, 30.10.2017 - Sunday, 05.11.2017	
	9		Monday, 06.11.2017 - Sunday, 12.11.2017	
	10		Monday, 13.11.2017 - Sunday, 19.11.2017	
	11		Monday, 20.11.2017 - Sunday, 26.11.2017	
	12		Monday, 27.11.2017 - Sunday, 03.12.2017	01.12.2017, Friday - Prophet Muhammad's Birthday
	13		Monday, 04.12.2017 - Sunday, 10.12.2017	
	14		Monday, 11.12.2017 - Sunday, 17.12.2017	
	15		Monday, 18.12.2017 - Sunday, 24.12.2017	
	16	Revision Week	Monday, 25.12.2017 - Sunday, 31.12.2017	25.12.2017, Monday-Christmas
	17	Examinations (3 Weeks)	Monday, 01.01.2018 - Sunday, 07.01.2018	01.01.2018, Monday-New Year 2018
	18		Monday, 08.01.2018 - Sunday, 14.01.2018	
	19		Monday, 15.01.2018 - Sunday, 21.01.2018	
	20	Mid Semester Break (3 Weeks)	Monday, 22.01.2018 - Sunday, 28.01.2018	
	21		Monday, 29.01.2018 - Sunday, 04.02.2018	31.01.2018. Wednesday- Thaipusam**
	22		Monday, 05.02.2018 - Sunday, 11.02.2018	
TWO	1/23	Teaching & Learning Period (T&LP - 7 Weeks)	Monday, 12.02.2018 - Sunday, 18.02.2018	16 & 17.02.2018, Friday & Saturday - Chinese New Year
	2/24		Monday, 19.02.2018 - Sunday, 25.02.2018	
	3/25		Monday, 26.02.2018 - Sunday, 04.03.2018	
	4/26		Monday, 05.03.2018 - Sunday, 11.03.2018	
	5/27		Monday, 12.03.2018 - Sunday, 18.03.2018	
	6/28		Monday, 19.03.2018 - Sunday, 25.03.2018	
	7/29		Monday, 26.03.2018 - Sunday, 01.04.2018	
	8/30	Mid Semester Break	Monday, 02.04.2018 - Sunday, 08.04.2018	
	9/31	Teaching & Learning Period (T&LP – 7 Weeks)	Monday, 09.04.2018 - Sunday, 15.04.2018	
	10/32		Monday, 16.04.2018 - Sunday, 22.04.2018	
	11/33		Monday, 23.04.2018 - Sunday, 29.04.2018	
	12/34		Monday, 30.04.2018 - Sunday, 06.05.2018	01.05.2018, Tuesday - Labour Day
	13/35		Monday, 07.05.2018 - Sunday, 13.05.2018	
	14/36		Monday, 14.05.2018 - Sunday, 20.05.2018	
	15/37		Monday, 21.05.2018 - Sunday, 27.05.2018	Examinations start on 23.05.2018 - 13.06.2018
	16/38	Examinations (3 Weeks)	Monday, 28.05.2018 - Sunday, 03.06.2018	29.05.2018, Tuesday - Wesak Day 02.06.2018, Saturday - Nuzul Al-Quran
	17/39		Monday, 04.06.2018 - Sunday, 10.06.2018	
	18/40		Monday, 11.06.2018 - Sunday, 17.06.2018	15 & 16.06.2018, Friday & Saturday - Eid-ul fitr**
*KSCP	19/41	Long Vacation/ Industrial Training/ KSCP* (11 Weeks)	Monday, 18.06.2018 - Sunday, 24.06.2018	
	20/42		Monday, 25.06.2018 - Sunday, 01.07.2018	
	21/43		Monday, 02.07.2018 - Sunday, 08.07.2018	07.07.2018, Saturday - Penang Heritage & Penang Governor's Birthday
	22/44	*T&LP	Monday, 09.07.2018 - Sunday, 15.07.2018	
	23/45		Monday, 16.07.2018 - Sunday, 22.07.2018	
	24/46	*Examination	Monday, 23.07.2018 - Sunday, 29.07.2018	28.07.2018, Saturday - Agong's Birthday
	25/47		Monday, 30.07.2018 - Sunday, 05.08.2018	
	26/48		Monday, 06.08.2018 - Sunday, 12.08.2018	
	27/49		Monday, 13.08.2018 - Sunday, 19.08.2018	
	28/50		Monday, 20.08.2018 - Sunday, 26.08.2018	22.08.2018, Wednesday-Eid-ul-adha**
	29/51		Monday, 27.08.2018 - Sunday, 02.09.2018	31.08.2018, Friday - National Day

*Courses during the Long Vacation (KSCP)

**This Academic Calendar is subject to change

1.0 INTRODUCTION

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

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

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

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

1.1 History and Development

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

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

The expansion that took place required an increase in the physical space of the campus. Since the physical area of USM in Penang at the time was rather limited, a new area in the state of Perak was identified as the site for the development of a branch campus.

A decision was reached whereby all fields of engineering studies were transferred to Perak while the School of Industrial Technology remained in Penang. In 1986, the

School of Electrical and Electronics Engineering and the School of Materials and Mineral Resources Engineering moved to a temporary campus at the old Ipoh Town Council building while waiting for the construction of the USM branch campus in Bandar Baru Seri Iskandar, Perak Tengah District, Perak to be completed. The temporary campus was named USM Perak Branch Campus (USMKCP – USM Kampus Cawangan Perak).

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

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

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

In 1997, the government decided to transfer USMKCP back to Penang. The new campus site was located in Seri Ampangan, Nibong Tebal, Seberang Perai Selatan, Penang while USMKCP's campus site in Seri Iskandar was taken over by the Universiti Teknologi Petronas (UTP).

The Engineering Campus moved in stages in 2001. USM's Engineering Campus in Seri Ampangan, Nibong Tebal began its operations in the 2001/2002 Academic Session in June 2001.

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

On 4th of September 2008, USM was granted with an APEX (the Accelerated Programme for Excellence) status by the Malaysian's government. USM's transformation plan, entitled "Transforming Higher Education for a Sustainable Tomorrow" will embark on numerous transformational journeys, including revamping most of its activities pertaining to nurturing and learning, research and innovation, services, students and alumni and the management of the university as a whole.

The University takes steps to improve the three core pillars of its strengths, [i] concentration of talent, [ii] resources and [iii] acculturation of supportive governance.

1.2 Philosophy and Objective

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

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

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

1.3 Outcome Based Education

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

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

(i) Engineering Knowledge - Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems;

(ii) Problem Analysis - Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;

(iii) Design/Development of Solutions - Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations;

(iv) Investigation - Conduct investigation into complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;

(v) Modern Tool Usage - Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations;

(vi) The Engineer and Society - Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice;

(vii) Environment and Sustainability - Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development;

(viii) Ethics - Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice;

(ix) Communication - Communicate effectively on complex engineering activities with the 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;

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

(xi) Life Long Learning - 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.

(xii) Project Management and Finance - Demonstrate knowledge and understanding of engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments;

1.4 Continuous Quality Improvement System

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

Feedbacks from the students are obtained from the School-Student Committee and Interview Session with each student before their convocation. Feedbacks from the alumni are obtained from the USM Alumni Relations Unit and the School's alumni

communities such as email, webpage and Facebook. All these feedbacks are incorporated for deliberations and approval by the Curriculum Review Committee which convenes annually to identify any particular course or programme that need to be revamped or to undergo minor/major changes.

1.5 External Examiner

Universiti Sains Malaysia has appointed external examiners to:

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

1.6 Industrial Advisory Panel

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

1.7 Industry and Community Network

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

1.8 Stakeholder

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

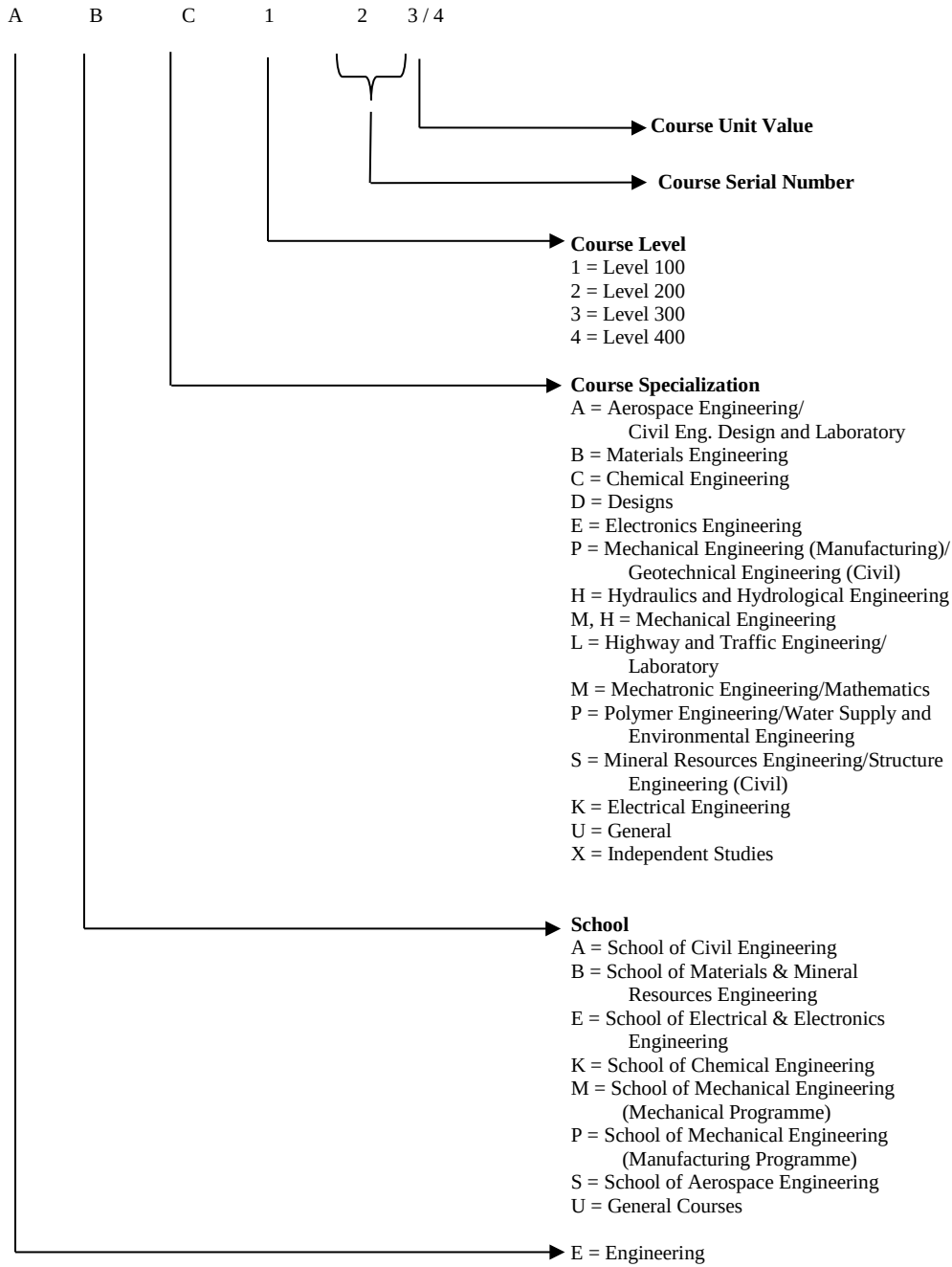
- Academic Staffs (University)
- Employers (industry and government)
- Alumni
- Students
- Parents

1.9 Teaching Delivery Method

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

1.10 Course Code

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



1.11 Programme Structure

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

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

Note:

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

1.12 Course Offering

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

Core Courses

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

Elective Courses

Students need to accumulate no less than 12 units from the list of courses suggested and acknowledged by the school.

Optional Courses

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

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

Audit Courses

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

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

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

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

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

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

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

Laboratory Work/Practical, Engineering Practice and Industrial Training

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

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

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

General Objectives of Engineering Practice

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

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

The Engineering Practice will be conducted in the following manner:

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

(i) Engineering Practice Course

The Engineering Practice Course is a basic training course on mechanical, manufacturing and electrical engineering. The training includes engineering workshops, introduction to manufacturing processes and electrical circuit. Engineering students will also be exposed to methods of engineering planning and project implementation. The duration of the training is 14 weeks and during this period, students will be supervised by the academic staff on duty.

(ii) Industrial Training

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

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

1.13 Graduation Requirements

Starting from the Academic Session 2015/2016, the intakes of this session for all programmes offered by the School of Electrical and Electronic Engineering are required to obtain a minimum of Grade C for each course taken

Students must also fulfil the following requirements to graduate:-

(a) Fulfil the minimum residential requirement (8 semesters) during the course of studies.

(b) Fulfil all the credit requirements of the courses and required units for each component (Core, Elective, Option and University Courses).

(c) Obtain an overall CGPA of 2.00 and above for Core courses.

(d) Obtain an overall CGPA of 2.00 and above for all courses.

(e) Achieve a minimum grade C or a grade point of 2.00 for Bahasa Malaysia, English Language courses, Islamic and Asian Civilisations, Ethnic Relations course and Core Entrepreneurship.

2.0 ACADEMIC SYSTEM AND GENERAL INFORMATION

2.1 Course Registration

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

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

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

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

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

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

2.1.2 Course Registration Platform

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

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

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

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

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

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

(ii) Access to *E-Daftar* System

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

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

OCR activities are conducted in the Schools/Centres and are applicable to students who are academically active and under Probation (P1/P2) status. Students who face difficulties registering their courses during the *E-Daftar* period can register their courses during the official period of OCR alternatively. Each school is responsible for scheduling this activity.

The official period for OCR normally starts on the first day of the semester (without the penalty charge of RM50.00). After this

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

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

2.1.3 The Frequency of Course Registration in One Academic Session

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

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

2.1.4 General Guidelines before Students Register for Courses

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

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

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

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

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

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

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

(iii) Type of course codes during registration:

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

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

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

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

(iv) Advice and approval of the Academic Advisor

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

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

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

(i) The information of Academic Advisor.

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

(iii) Cangred and Course Registration Form.

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

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

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

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

2.1.6 Registration of Language and Co-Curriculum Courses

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

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

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

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

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

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

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

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

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

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

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

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

2.1.7 Registration of 'Audit' Courses (Y code)

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

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

2.1.8 Registration of Prerequisite Courses (Z code)

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

2.1.9 Late Course Registration/Late Course Addition

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

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

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

2.1.10 Dropping of Courses

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

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

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

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

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

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

repeat the course during the *Courses during the Long Vacation* (KSCP) period.

2.1.11 Course Registration Confirmation Slip

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

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

Personal and academic information for each student can be checked through the Campus Online portal (https://campusonline.usm.my). Students are advised to always check all the information displayed on this website.

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

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

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

2.1.13 Academic Advisor

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

Academic Advisors will advise their students under their responsibility on academic-related matters. **Important advice for the students includes the registration planning for certain courses**

in each semester during the study period. Before registering the course, students are advised to consult and discuss with their Academic Advisors to determine the courses to be registered in a semester.

2.2 Interpretation of Unit/Credit/Course

2.2.1 Unit

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

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

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

One unit is equivalent to 40 hours of student learning time

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

2.2.2 Accumulated Credit Unit

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

2.3 Examination System

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

2.3.1 Duration of Examination

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

2.3.2 Barring from Examination

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

2.3.3 Grade Point Average System

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

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

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

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

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

The formula to compute GPA and CGPA is as follows:

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

where:

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

Example of calculation for GPA and CGPA:

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

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

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

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

CGPA = Total Accumulated GP = 43.66 + 40.99 = 84.65 = 2.23
Total Accumulated Unit 20 + 18 38

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

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

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

The purpose of KSCP is to:

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

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

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

The Implementation of KSCP

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

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

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

(iii) GPA calculation involves the **LATEST** grades (obtained in KSCP) and also involves courses taken in the second semester and those repeated in KSCP. If the GPA during KSCP as calculated above is 2.00 or better, the academic status will be active, even though the academic status for the second semester was probation status. However, if the GPA for KSCP (as calculated above) is 1.99 or below, the academic status will remain as probation status for the second semester.

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

2.3.5 Academic Status

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

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

2.3.6 Termination of Candidature

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

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

2.3.7 Examination Results

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

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

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

2.4 Unit Exemption

2.4.1 Unit Exemption

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

2.4.2 Regulations and Implementation of Unit Exemption

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

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

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

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

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

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

(vi) **In order to obtain unit exemption for industrial training**, a student must have continuous work experience for at least two years in the area. If a student has undergone industrial training during the period of diploma level study, the student must have work experience for at least one year. The students are also required to produce a report on the level and type of work performed. Industrial training unit exemption cannot be considered for semester exemption as the industrial training is carried out during the long vacation in USM.

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

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

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

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

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

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

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

2.4.3 Total Number of Exempted Semesters

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

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

2.4.4 Application Procedure for Unit Exemption

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

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

2.5 Credit Transfer

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

(a) <u>Category of Students Who Can Be Considered for Credit Transfer</u>

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

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

(b) Specific Conditions

(i) Basic and Core Courses

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

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

(ii) Elective or Option Courses

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

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

(iii) Minor Courses

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

(c) General Conditions

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

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

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

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

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

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

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

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

2.5.1 Application Procedure for Attending Courses/Credit Transfer

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

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

2.6 Academic Integrity

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

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

Universiti Sains Malaysia encourages its students to be respectful of and to ensure that any matter relating to academic integrity will be well-preserved. Universiti Sains Malaysia always encourages its students to ensure that manners,

ethics and integrity would be essential in academics while focusing on their studies in Universiti Sains Malaysia.

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

(a) Cheating

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

- Copying answers from others during a test or an exam.
- Any suspicious action that can be described as cheating or an attempt to cheat in an exam.
- Using unauthorized materials or devices without authorization (calculator, PDA, mobile phones, pager, or any smart device, and other unauthorized devices) during a test or an exam.
- Asking or allowing another student to take a test or an exam on behalf and vice-versa.
- Sharing answers or programmes for an assignments or projects.
- Purposely tampering with marked/graded after it has been returned, and then re-submitting it for remarking/regrading.
- Give command, to force, persuade, deceive or blackmail others to conduct research, do writing, programming or any task for personal gain.
- Submitting any identical or similar work in more than one course without consulting or prior permission from the lecturers concerned.

(b) Plagiarism

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

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

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

POLICY ON PLAGIARISM OF UNIVERSITI SAINS MALAYSIA

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

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

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

Plagiarism is defined as the act of presenting, quoting, copying, paraphrasing or passing off ideas, images, processes, works, data, personal words or those of other people or sources without any proper acknowledgement, reference to or quotation of the original source(s). The acts of plagiarism include, but are not limited to, the following:

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

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

(c) Fabrication

Fabrication refers to a process of invention, adaptation or copying with the intention of cheating. This is an act of deceiving other people. Fabrication is somewhat related to matters which have been 'created' or altered. Invention or task outcome or academic work without acknowledgement, alteration, falsification or misleading use of data, information or citation in any academic work constitutes fabrication. Fabricated information neither

represent the student's own effort nor the truth concerning a particular investigation or study, and thus violating the principle of truth in knowledge. Some examples are:

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

(d) Collusion

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

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

(e) Other violations relating to academic integrity

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

2.6.1 Consequences of Violating Academic Integrity

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

If in any specific event a student or students would encounter any incident that denotes academic dishonesty, the student(s) need to submit a report to the relevant lecturer. The lecturer is then

responsible to investigate and substantiate the violation and report the matter to the Dean of the School.

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

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

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

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

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

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

2.7 USM Mentor Programme

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

Objectives

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

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

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

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

2.8 Student Exchange Programme

2.8.1 Study Abroad Scheme

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

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

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

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

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

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

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

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

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

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

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

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

3.0 UNIVERSITY REQUIREMENTS

3.1 Summary of University Requirements

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

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

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

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

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

3.2 Bahasa Malaysia

(a) Local Students

The requirements are as follows:

- LKM400/2 - Bahasa Malaysia IV

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

Entry requirements for Bahasa Malaysia are as follows:

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

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

(b) International Students

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

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

Code	Type	Units
LKM100	U	2

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

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

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

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

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

Code	Type	Units
LKM200	U	2
LKM300	U	2

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

3.3 English Language

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

(a) Entry Requirements for English Language Courses

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

* MUET: Malaysian University English Test.

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

Note:

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

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

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

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

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

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

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

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

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

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

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

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

SHE 101 – Ethnic Relations (2 units)

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

hoped that students will be able to identify and apply the skills to issues associated with ethnic relations in Malaysia.

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

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

WUS 101 – Core Entrepreneurship (2 units)

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

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

3.5 International Students - Malaysian Studies/Option

(a) Malaysian Studies

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

SEA205E - Malaysian Studies (4 Units)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Packaged (Students are required to complete all levels)			
Community Service (2 Years)	**Jazz Band (3 Years)**	**Karate (3 Semesters)**	**Taekwondo (3 Semesters)**
WKM101/2	WCC108/2	WSC108/1	WSC115/1
WKM201/2	WCC208/2	WSC208/1	WSC215/1
	WCC308/2	WSC308/1	WSC315/1
Non-Packaged (1 Semester)			
Culture		**Sports**	
WCC103/1 - Catan (Painting)		WSC105/1 - Bola Tampar (Volley Ball)	
WCC105/1 - Gamelan		WSC106/1 - Golf	
WCC107/1 - Guitar		WSC110/1 - Memanah (Archery)	
WCC109/1 - Koir (Choir)		WSC111/1 - Ping Pong (Table Tennis)	
WCC110/1 - Kraftangan (Handcrafting)		WSC112/1 - Renang (Swimming)	
WCC115/1 - Tarian Moden (Modern Dance)		WSC113/1 - Aerobik (Aerobics)	
WCC116/1 - Tarian Tradisional (Traditional Dance)		WSC114/1 - Skuasy (Squash)	

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

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

Course Synopsis

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

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

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

(v) English Language Courses

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

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

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

(vi) Foreign Language Courses

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

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

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

4.0 SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING

http://ee.eng.usm.my

4.1 INTRODUCTION

Since the academic session of 2000/2001, the School of Electrical and Electronic Engineering offers two study programmes, i.e the Electronic Engineering Programme leading to the Bachelor of Engineering (Honours) (Electronic Engineering) and Electrical Engineering Programme leading to the Bachelor of Engineering (Honours) (Electrical Engineering). As of 2002/2003, another programme has been offered, which is the Mechatronic Engineering Programme leading to the Bachelor of Engineering (Honours) (Mechatronic Engineering). The duration of the three mentioned programmes are four years or eight semesters.

Electronic Engineering

The Electronic Engineering programme covers Microelectronics, Computers, Communications and Control and Automation.

Microelectronics:

- includes Design and Analysis of Electronic Circuits, Digital Systems Design, Semiconductors, Electronic Devices and Circuits and various aspects of Integrated Electronics.

Computers:

- includes Computer Organisation, Computer Networking, Microprocessor Systems Design, Digital Signal Processing, Software Engineering and Parallel Processing.

Communications:

- includes Theory of Communication Systems, Antenna and Propagation, Microwave Engineering, Radar and Satellite Communications.
- includes Control and Automation: Includes Analysis and Design of Control Systems, Robotics and Automation, exposure to the FMS systems and the industrial sector.

Electrical Engineering

The areas to be undertaken for the Electrical Engineering programme covers Power Generation (both conventional and unconventional methods), Transmission, Distribution and Consumption, Electrical Machines, Analysis, Design, Applications, Power System Stability and Power Electronics.

Mechatronic Engineering

The Mechatronic Engineering Programme covers fundamentals of electrical, mechanical and computer engineering, system and control engineering, mechatronic system and design, sensors and transducers, robotics, machine vision and manufacturing.

4.2 OBJECTIVES AND PHILOSOPHY

The vision of Universiti Sains Malaysia is:-
"Transforming Higher Education for a Sustainable Tomorrow"

The mission of Universiti Sains Malaysia is:-
"USM is pioneering, transdisciplary research intensive university that empowers future talents and enables the bottom billions to transform their economic well-being"

The mission of the School of Electrical and Electronic Engineering is:-
"To provide quality education and sustainable research that produces professionals with the necessary knowledge, skills and character that is required for the advancement of engineering and technology".

In line with these vision and missions, the offering of the Electronic, Electrical and Mechatronic Engineering programmes were designed to produce Electrical, Electronic and Mechatronic engineers with professional qualifications, skilled and knowledgable, credible and able to find solutions to various engineering problems through innovative thinking.

Based on this philosophy, the goals of the curriculum of every study programmes have been designed to fulfil the nation's Vision 2020, as well as industrial and current technological advancement needs. Hence, the curriculum has been organised to possess the following characteristics :

- recognised by Board of Engineers Malaysia (BEM), The Institution of Engineers Malaysia (IEM) as well as to be internationally acclaimed
- proper and balanced integration of practical and theoretical aspects
- with a complete choice of many well planned and advanced specialisation
- to develop persons of sound character who are knowledgeable, competent and innovative

With the above characteristics, USM graduates will become graduate engineers of excellence, calibre and able to achieve the high level of professionalism as engineers or researchers in their respective fields.

4.3 IMPLEMENTATION OF OUTCOME BASED EDUCATION (OBE)

Starting from the 2006/2007 academic session, the new intake of students will undergo a set of curriculum known as Outcome Based Education. Briefly, OBE is a method of curriculum design and teaching that focuses on what students can actually do after they are taught.

Under OBE, there are three Programme Educational Objectives (PEOs) as follows :-

Bachelor of Engineering (Honours)
(Electronic Engineering)

1. Graduates who are employed in the Electronic Engineering related fields.
2. Graduates who are innovative, pursue continuous career development, and participate in society related activities.
3. Graduates who have leadership qualities, ethical values and awareness in sustainability issues.

Bachelor of Engineering (Honours)
(Electrical Engineering)

1. Graduates who are employed in the Electrical Engineering related fields.
2. Graduates who are innovative, pursue continuous career development, and participate in society related activities.
3. Graduates who have leadership qualities, ethical values and awareness in sustainability issues.

Bachelor of Engineering (Honours)
(Mechatronic Engineering)

1. Graduates who are employed in the Mechatronic Engineering related fields.
2. Graduates who are innovative, pursue continuous career development, and participate in society related activities.
3. Graduates who have leadership qualities, ethical values and awareness in sustainability issues.

Also under the OBE, each programme should have Programme Outcomes (POs) that describe what students are expected to know and be able to perform or attain by the time of graduation. The School is adopting the POs as stated by Washington Accord and Engineering Accreditation Council in its 2012 EAC Manual as follows:-

PO1- Engineering Knowledge
Ability to apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.

PO2- Problem Analysis
Ability to identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3- Design/Development of Solutions
Ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO4- Investigation
Ability to conduct investigation of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, synthesis of information to provide valid conclusion.

PO5-Modern Tool Usage
Ability to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.

PO6- The Engineer and Society
Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.

PO7- Environment and Sustainability
Ability to understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.

PO8 – Ethics
Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9- Individual and TeamWork
Ability to function effectively as an individual, and as a member or leader in teams and in multi-disciplinary settings.

PO10- Communication
Ability to communicate effectively on complex engineering activities with the 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.

PO11- Project Management and Finance
Ability to demonstrate knowledge and understanding of engineering and management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12- Life Long Learning
Ability to 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.

4.4 MAIN ADMINISTRATIVE STAFFS

Professor Ir. Dr. Mohd Rizal Arshad
Dean

Professor Ir. Dr. Mohd Fadzil Ain
Deputy Dean (Research, Postgraduate & Networking)

Profesor Ir. Dr. Nor Ashidi Mat Isa
Deputy Dean (Academic, Student & Alumni),

Assoc. Prof. Dr. Bakhtiar Affendi Rosdi
Programme Chairman (Electronic Engineering)

Assoc. Prof. Ir. Dr. Mohammad Kamarol Mohd Jamil
Programme Chairman (Electrical Engineering)

Assoc. Prof. Dr. Rosmiwati Mohd Mokhtar
Programme Chairman (Mechatronic Engineering)

Assoc. Prof. Ir. Dr. Dahaman Ishak
Coordinator (Quality & Commersialisation)

Ms. Jelfariny Mohd Jelahni
Principal Assistant Registrar

Mdm. Normala Omar
Assistant Registrar

4.5 LIST OF ACADEMIC STAFFS

Name	Telephone Extension	E-mail
PROFESSORS		
Mohd Fadzil bin Ain, Ir. Dr.	5843	eemfadzil@usm.my
Nor Ashidi bin Mat Isa, Ir. Dr.	6003	ashidi@usm.my
Mohd Rizal bin Arshad, Ir. Dr.	6000	eerizal@usm.my
Widad bt. Ismail, Dr.	6050	eewidad@usm.my
Mohd Zaid bin Abdullah, Dr.	6030	mza@usm.my
ASSOCIATE PROFESSORS		
Arjuna bin Marzuki, Ir. Dr.	6021	eemarzuki@usm.my
Asrulnizam bin Abd. Manaf, Dr.	6013	eeasrulnizam@usm.my
Bakhtiar Affendi bin Rosdi, Dr.	6083	eebakhtiar@eng.usm.my
Dahaman bin Ishak, Ir. Dr.	5810	dahaman@usm.my
Dzati Athiar binti Ramli, Dr.	6028	dzati@usm.my
Haidi bin Ibrahim, Dr.	5822	haidi@usm.my
Harsa Amylia binti Mat Sakim, Dr.	5821	amylia@usm.my
Junita binti Mohamad Saleh, Dr.	6027	jms@usm.my
Khoo Bee Ee, Dr.	6032	beekhoo@usm.my
Mohammad Kamarol bin Mohd Jamil, Ir. Dr.	6064	eekamarol@usm.my
Mohd Fadzli bin Mohd Salleh, Dr	6058	fadzlisalleh@usm.my
Norlaili binti Mohd. Noh, Ir. Dr.	6023	eelaili@usm.my
Rosmiwati binti Mohd Mokhtar, Dr.	6056	eerosmiwati@usm.my
Shahrel Azmin bin Sundi @ Suandi, Dr.	5814	shahrel@usm.my
Syafrudin Masri, Ir. Dr.	6018	syaf@usm.my
Zaini binti Abdul Halim, Dr.	6061	zaini@usm.my
SENIOR LECTURERS		
Aeizaal Azman bin Abd Wahab, Dr.	5762	aeizaal@usm.my
Aftanasar bin Md. Shahar, Dr.	6085	afta@usm.my
Ahmad Nazri bin Ali, Mr.	6020	nazriali@usm.my
Anwar Hasni bin Abu Hassan, Dr	6031	eeanwar@usm.my
Mohamad Adzhar bin Md Zawawi,Dr.	6052	adzhar@usm.my
Mohamad Khairi bin Ishak, Dr.	5737	khairiishak@usm.my
Mohamed Fauzi bin Packeer Mohamed, Dr.	6097	fauzi.packeer@usm.my
Muhammad Nasiruddin bin Mahyuddin, Dr.	6099	nasiruddin@usm.my

Mohd Ilyas Sobirin bin Mohd Sazali, Dr.	6079	ilyas.sazali@usm.my
Mohd Khairunaz bin Mat Desa, Dr.	5873	khairunaz@usm.my
Mohd Tafir bin Mustaffa, Dr.	6029	tafir@usm.my
Nor Asiah binti Muhamad, Ir. Dr.	5726	norasiah.m@usm.my
Nor Rizuan bin Mat Noor, Dr.	6077	nrmn@usm.my
Nur Zatil Ismah binti Hashim, Dr.	6034	zatil.hashim@usm.my
Nor Muzlifah binti Mahyuddin, Dr.	5789	eemnmuzlifah@usm.my
Nur Syazreen binti Ahmad, Dr.	6014	syazreen@usm.my
Patrick Goh Kuan Lye, Dr.	6033	eepatrick@usm.my
Syed Sahal Nazli Alhady bin Syed Hassan, Dr.	6019	sahal@usm.my
Tay Lea Tien, Dr.	6082	tay@usm.my
Teh Jiashen, Dr.	6016	jiashenteh@usm.my
Teoh Soo Siang, Dr	6081	eeteoh@usm.my
Wan Amir Fuad Wajdi bin Othman, Dr.	6062	wafw_othman@usm.my
Wan Mohd Yusof Rahiman bin Wan Abdul Aziz, Dr.	6024	wanrahiman@usm.my
Zuraini bt. Dahari, Dr.	6048	eezuraini@usm.my
Zulfiqar Ali bin Abdul Aziz, Mr.	6065	eezulfiq@usm.my
LECTURERS		
Mohd Nazri bin Mahmud, Mr.	6059	nazriee@usm.my
RESEARCH OFFICERS		
Hazmarini binti Husin, Mdm.	5758	rini@usm.my
Husna binti Md Yusoff, Mdm.	5813	husna@usm.my
Mohamad Nazir bin Abdullah, Mr.	5802	eemnazir@usm.my
Mohd Nadzri bin Mamat, Mr.	5801	eenadzri@usm.my
Noramalina binti Abdullah, Mdm.	6022	eenora@usm.my
Roslina binti Hussin, Mdm.	6025	eeroslina@usm.my
Suardi bin Kaharuddin, Mr.	6057	suardi@usm.my

4.6 LIST OF EXTERNAL EXAMINER 2017/2018

Professor Dato' Ir. Dr. Mohd Marzuki Mustafa
Department of Electrical, Electronic & Systems Engineering
Universiti Kebangsaan Malaysia
Bangi Selangor, MALAYSIA

Professor Dr. Ir. Suwarno
School of Electrical Engineering and Informatics
Institut Teknologi Bandung
Bandung-West Java, INDONESIA

4.7 LIST OF INDUSTRIAL ADVISORY PANEL (IAP)

Mr. P.B. Teo
Director of Engineering (Research and Development)
Motorola Technology Sdn Bhd
Plot 2 Bayan Lepas, Technoplex Industrial Park
Mukim 12 S.W.D.
Bayan Lepas, Penang

Mrs. Noor Azian Abdul Wahab
Senior R&D Engineering Manager
National Instruments Malaysia Sdn. Bhd.
No: 8, Lebuh Batu Maung 1
Bayan Lepas, Pulau Pinang

Mr. Leow Cheah Wei
Head of Product
Techsource Systems Sdn Bhd
No: B-02-20 & 21, Krystal Point
303, Jalan Sultan Azlan Shah
Sungai Nibong, Pulau Pinang

Ir. Ahmad Fuad Md Kasim
Genaral Manager (Production Performance)
Distribution Division
Tenaga Nasional Berhad
Wisma TNB, No:19, Jalan Timur
Petaling Jaya, Selangor

Mr. Mohamad Nasrul Abdul Satar
Senior R&D Electronic Engineer
Continental Automotive Malaysia
MK1 2455, Tingkat Perusahaan 2A,
Prai Industrial Estate
Perai, Penang

Ir. Dr. Muhammad Arkam Che Munaaim
Director (North Region)
Mega Jati Consult Sdn Bhd
No: 36, Lorong Pauh Jaya 4/4
Taman Pauh Jaya
Perai, Pulau Pinang

Mr. Chu Jenn Weng
President & CEO
ViTrox Corporation Bhd
No. 85-A, Lintang Bayan Lepas 11
Bayan Lepas Industrial Park, Phase 4
Bayan Lepas, Penang

Mr. Hassan Hussain
Vice President and General Manager
Motion Control Product Division
Avago Technologies
No: 9, Persiaran Kikik 5
Taman Inderawasih
Pulau Pinang

Mr. Noor Hafizi Hanafi
Senior Staff Engineer
Continental Automotive Sdn Bhd
MK1 2455, Tingkat Perusahaan 2A,
Prai Industrial Estate
Perai, Penang

4.8 LABORATORY FACILITIES

All of the labs at the School are equipped with modern and advanced facilities to support the Undergraduate and Post Graduate study programmes as well as serve the needs for academic excellence.

The School has a number of laboratories for both teaching and research purposes. Among the labs are:-

(a) Microelectronic Lab in CEDEC
(b) Electronic Lab
(c) Communications System Lab
(d) Microwave and RF Lab (Donated by Agilent)
(e) Circuit Board Processing Lab
(f) Microprocessor Lab (Donated by Intel)
(g) Microcomputer Lab
(h) Automation Lab
(i) Instrumentation & Control Lab
(j) Robotics Lab
(k) Power and Machines Lab
(l) Workstation Lab
(m) Data Communications Lab
(n) Electronic Systems Design Lab
(o) Mechatronic Lab
(p) Digital Signal Processing Lab (Donated by Motorola)
(q) Satellite Research Lab (Donated by the Japanese Government)
(r) Image Processing Research Lab

4.9 JOB OPPORTUNITIES

The graduates of the Bachelors in Engineering Degree in areas of Electronic, Electrical and Mechatronic Engineering have great job prospects in the private sector as well as the civil service. These include the manufacturing industry, firms which are based on electrical and electronics, computers, communications, power, robotics and automation.
Among the areas that offer work opportunities in the private sector are:

- manufacturing and industrialisation
- electrical and electronics
- telecommunications and RF
- information technology and computers
- microelectronics
- electrical machines and drive controls
- power generation and distribution
- instrumentation
- Among the job descriptions that fit our graduates are :
- Process and Manufacturing Engineers
- Consultant Engineers
- Research and Design Engineers
- Administrative Management and Commerce
- Quality and Test Engineer

4.10 POST GRADUATE STUDIES AND RESEARCH PROGRAMMES

The school also offers Graduate Study Programmes through research in various engineering fields for the Masters in Science Degree (M.Sc) or Doctor of Philosophy Degree (Ph.D). Both courses may be taken in full-time or part-time mode in the areas as listed below:

- Microelectronics
- Microwave Engineering and RF
- Image Processing
- Power Engineering
- Control, Robotics and Automation
- Neural Networks
- Embedded Systems Design
- Mechatronic Engineering
- Communication Systems
- Antennas and Propagation

Every candidate of the Masters in Science Degree (M.Sc) programme must fulfil the University enrolment requirements, and are usually graduates with good honours degree (at least with CGPA of 2.75) or equivalent qualifications in the Science or Engineering courses. Candidates with qualifications lower than Second Class will also be considered if they have vast experience in some specific areas of specialisation and approved by the School Board.

To further enhance the Post Graduate programmes, a Masters in Science Degree Programme by Coursework has been introduced. This degree is known as Masters in Science (M.Sc) Electronic Systems Design Engineering starting from the Academic Session 2003/2004 and Masters in Science (M.Sc) Microelectronic Engineering starting from the Acadamic Session 2013/2014.

5.0

STRUKTUR IJAZAH SARJANA MUDA KEJURUTERAAN (KEPUJIAN) KEJURUTERAAN ELEKTRONIK
BACHELOR ENGINEERING (HONS) (ELECTRONIC) STRUCTURE

	10				200				300				400			
	Semester 1		**Semester 2**		**Semester 3**		**Semester 4**		**Semester 5**		**Semester 6**		**Semester 7**		**Semester 8**	
TERAS *(Core)*	**EUM113/3** **Kalkulus Kejuruteraan** *(Engineering Calculus)*	**Cuti Pertengahan Semester *(Mid Semester Break)***	**EUM114/3** **Kalkulus Kej. Lanjutan** *(Advanced Engineering Calculus)*	**Cuti Panjang *(Long Vacation)***	**EEE232/3** **Analisis Kompleks** (*Complex Analysis)*	**Cuti Pertengahan Semester *(Mid Semester Break)***	**EEE243/3** **Makmal Elektronik Analog** *(Analog Electronics Lab)*	**Cuti Panjang *(Long Vacation)***	**EEE332/4** **Perhubungan** *(Communication)*	**Cuti Pertengahan Semester *(Mid Semester Break)***	**EEE379/3** **Sistem Komputer & Multimedia** *(Comp. System & Multimedia)*	**EEL303/5 Latihan Industri *(Industrial Training)***	**EEE443/3** **Pemprosesan Isyarat Digit** *(Digital Signal Processing)*	**Cuti Pertengahan Semester *(Mid Semester Break)***	**EEE499/6** **Projek Prasiswazah** *(Undergraduate Project)*	
	EBB113/3 **Bahan Kejuruteraan** *(Engineering Material)*		**EEE125/3** **Makmal Asas Litar** *(Basic Circuit Lab)*		**EEE231/3** **Makmal Elektronik Digit** *(Digital Electronic Lab)*		**EEE226/3** **Mikropemproses I** *(Microprocessor I)*		**EEE320/3** **Mikropemproses II** *(Microprocessor II)*		**EUP222/3** **Jurutera Dlm Masyarakat** *(Engineer In Society)*		**EEE424/3** **Reka Bentuk Kejuruteraan Elektronik** *(Electronic Eng. Design)*		**EEM 421/4** **Kaedah Kualiti** *(Quality Techniques)*	
	EMM101/3 **Mekanik Kejuruteraan** *(Engineering Mechanics)*		**EEE130/3** **Elektronik Digit I** *(Digital Electronic I)*		**EEE208/3** **Teori Litar II** *(Circuit Theory II)*		**EEE276/3** **Teori Elektromagnet** *(Electromagnetic Theory)*		**EEE378/3** **Elektronik Digit II** *(Digital Electronics II)*		**EEE354/3** **Sistem Kawalan Digit** (*Digital Control Systems)*					
	EEE105/3 **Teori Litar I** *(Circuit Theory I)*		**EEE133/3** **Peranti dan Litar Elektronik** *(Electronic Devices & CIrcuit)*		**EEE241/3** **Elektronik Analog I** *(Analog Electronics I)*		**EEK260/3** **Mesin Elektrik** *(Electrical Machines)*		**EEE382/3** ***Kebarangkalian & Statistik Kej.*** *(Probability & Engineering Statistic)*		**EEE348/3** **Pengantar Rekabentuk Litar Bersepadu** *(Intro.to Inter. Circuit Design)*					
	EEE123/3 **Pengaturcaraan Komputer untuk Jurutera** *(Comp. Prog. for Eng)*		**EEL102/2** **Amalan Kejuruteraan** *(Engineering Practice)*		**EEE228/3** **Isyarat & Sistem** *(Signal & System)*		**EEE270/3** **Elektronik Analog II** *(Analog Electronic II)*		**EEE350/3** **Sistem Kawalan** *(Control Systems)*							
	15		**14**		**15**		**15**		**16**		**12**	**5**	**6**		**10**	**108**
KEP. UNIV. *(Univ Req.)*	**LKM 400/2:** **B.Malaysia** *(Malay Language)*		**WUS101/2: Teras Keusahawanan** *(Core Entrepreneurship)*		**LSP/2: B.Inggeris** *(English Language)*		**HTU223/2 TITAS** *(Islamic and Asian Civilisations)*		**LSP/2 B.Inggeris** *(English Language)*						OPSYEN/3 *(Options/3)*	**15**
			SHE101/2: Hubungan Etnik *(Ethnic Relations)*													
ELEKTIF *(Elective)*	**CATATAN:** ***(Note)*** **Pilih SATU kursus Elektif pada Semester 6 dan sebarang DUA kursus Elektif pada Semester 7.** ***(Choose ONE Elective course from Semester 6 and any TWO Elective courses from Semester 7)***										**EEE322/4** **Kej. Gelombang Mikro & RF** *(RF & Microwave Eng)*		**EEE449/4** **Rangkaian Komp.** *(Computer Networks)*			**12**
											EEE344/4 **Sistem VLSI** *(VLSI System)*		**EEE430/4** **Kej. Perisian** *(Software Eng.)*			
											EEE355/4 **Robotik & Pengautomatan** *(Robotic & Automation)*		**EEE440/4** **Sis. Perhubungan Moden** *(Modern Comm. System)*			
											EEE377/4 **Perhubungan Digit** *(Digital Communication)*		**EEE432/4** **Antena & Perambatan** *(Antennas & Propagation)*			
													EEE445/4 **Rekabentuk Litar Analog Bersepadu** *(Analogue Integrated Circuit Design)*			
													EEE453/4 **Rekabentuk Sistem Kawalan** *(Control System Design)*			
Jumlah Unit per Semester	17		18		17		17		18		16	5	14		13 10 (tanpa opsyen)	135
	JUMLAH UNIT MINIMUM BAGI PENGIJAZAHAN *(TOTAL MINIMUM UNIT FOR GRADUATION)*															**135**

BACHELOR OF ENGINEERING (HONOURS) (ELECTRONIC ENGINEERING)

5.1 CURRICULUM

LEVEL 100

		Credit	Contact Hours	
		Total Unit	**Lecture**	**Lab/ Tutorial**
Semester I				
EEE105/3	Circuit Theory 1	3	3	1
EEE123/3	Computer Programming for Engineers	3	2	2
EBB113/3	Engineering Materials	3	3	1
EMM101/3	Engineering Mechanical	3	3	1
EUM113/3	Engineering Calculus	3	3	1
		15	**14**	**6**
SEMESTER BREAK				
Semester II				
EEE125/3	Basic Circuit Laboratory	3	0	6
EEE130/3	Digital Electronics 1	3	3	1
EEE133/3	Electronic Devices and Circuit	3	3	1
EEL102/2	Engineering Practices	2	0	4
EUM114/3	Advanced Engineering Calculus	3	3	1
		14	**9**	**13**
LONG VACATION				

LEVEL 200

		Credit	Contact Hours	
		Total Unit	**Lecture**	**Lab/ Tutorial**
Semester I				
EEE208/3	Circuit Theory II	3	3	1
EEE228/3	Signal and System	3	3	1
EEE231/3	Digital Electronic Laboratory	3	0	6
EEE232/3	Complex Analysis	3	3	1
EEE241/3	Analogue Electronics I	3	3	1
		15	**12**	**10**
SEMESTER BREAK				

Semester II				
EEE226/3	Microprocessors I	3	2	2
EEE243/3	Analogue Electronics Laboratory	3	0	6
EEE270/3	Analogue Electronics II	3	3	1
EEE276/3	Electromagnetic Theory	3	3	1
EEK260/3	Electrical Machines	3	3	1
		15	**11**	**11**
LONG VACATION				

LEVEL 300

		Credit	**Contact Hours**	
		Total Unit	**Lecture**	**Lab/ Tutorial**
Semester I				
EEE320/3	Microprocessors II	3	2	2
EEE332/4	Communications	4	4	1
EEE350/3	Control Systems	3	3	1
EEE378/3	Digital Electronics II	3	3	1
EEE382/3	Probability & Engineering Statistic	3	3	1
		16	**15**	**6**
SEMESTER BREAK				
Semester II				
EEE348/3	Introduction to Integrated Circuit Design	3	3	1
EEE354/3	Digital Control Systems	3	3	1
EEE379/3	Computer Systems And Multimedia	3	3	2
EUP222/3	Engineers in Society	3	3	1
		12	**12**	**5**
EEL303/5	Industrial Training (10 WEEKS)	**5**	**0**	**10**
Elective				
EEE322/4	Microwave & RF Engineering	4	2	4
EEE344/4	VLSI Systems	4	3	2
EEE355/4	Robotics & Automation	4	3	2
EEE377/4	Digital Communications	4	3	2
LONG VACATION				

LEVEL 400

		Credit	Contact Hours	
		Total Unit	Lecture	Lab/ Tutorial
Semester I				
EEE424/3	Electronic Engineering Design	3	1	4
EEE443/3	Digital Signal Processing	3	3	2
		6	**4**	**6**
Elective				
EEE430/4	Software Engineering	4	3	2
EEE432/4	Antennas and Propagation	4	3	2
EEE440/4	Modern Communication Systems	4	3	2
EEE445/4	Integrated Analogue Circuit Design	4	3	2
EEE449/4	Computer Networks	4	3	2
EEE453/4	Control System Design	4	3	2
SEMESTER BREAK				
Semester II				
EEE499/6	Undergraduate Project	6	0	12
EEM421/4	Quality Techniques	4	4	0
		10	**4**	**12**
LONG VACATION				

5.2 COURSE- PROGRAMME OUTCOMES MATRIX

			EMPHASIS TO THE PROGRAM OUTCOMES											
			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
COURSE CODE	**SEM**	**DESCRIPTION**												
Level 100														
1	EUM 113/3	1	Engineering Calculus	X	X									
2	EEE105/3	1	Circuit Theory I	X	X									
3	EEE123/3	1	Computer Programming for Engineers		X	X								X
4	EUM114/3	2	Advanced Engineering Calculus	X	X									
5	EEE125/3	2	Basic Circuit Lab			X					X	X	X	
6	EEE130/3	2	Digital Electronic I		X				X					
7	EEE133/3	2	Electronic Devices & Circuit	X						X				

8	EEL102/2	2	Engineering Practice			X		X				X	X		

Level 200

9	EEE208/3	3	Circuit Theory II		X		X			X					
10	EEE226/3	4	Microprocessor 1			X					X	X			X
11	EEE228/3	3	Signal & System	X	X										
12	EEE231/3	3	Digital Electronic Lab					X			X	X		X	
13	EEE232/3	3	Complex Analysis		X		X								
14	EEE241/3	3	Analog Electronic I	X					X						
15	EEE243/3	4	Analog Electronics Lab			X		X					X	X	
16	EEE270/3	4	Analog Electronic II		X		X	X							
17	EEE276/3	4	Electromagnetic Theory		X				X						
18	EUP 222/3	4	Engineers in Society	X			X		X		X	X		X	

Level 300

19	EEE320/3	5	Microprocessor II			X							X		X
20	EEE322/4	6	RF & Microwave Engineering				X			X					
21	EEE332/4	5	Communication			X					X				
22	EEE344/4	6	VLSI Systems			X		X							
23	EEE348/3	6	Introduction to Inter. Circuit Design	X							X				
24	EEE350/3	5	Control Systems		X		X	X							
25	EEE354/3	6	Digital Control Systems		X		X	X							
26	EEE355/4	6	Robotic & Automation			X		X							
27	EEL 303/5	6	Industrial Training						X			X		X	X
28	EEE377/4	6	Digital Communication			X	X								
29	EEE378/3	5	Digital Electronics II		X		X					X			
30	EEE379/3	6	Comp. System & Multimedia			X							X		
31	EEE382/3	5	Probability & Eng. Statistics			X			X						

Level 400

32	EEE424/3	7	Electronic Eng. Design			X			X	X		X	X	X	X
33	EEE430/4	7	Software Engineering		X		X			X					
34	EEE432/4	7	Antennas & Propagation			X		X							
35	EEE440/4	7	Modern Comm. System			X	X								
36	EEE443/3	7	Digital Signal Processing			X	X			X					
37	EEE445/4	7	Design of Integrated Analog Circuit			X			X						
38	EEE449/4	7	Computer Networks			X		X							
39	EEE499/6	8	Undergraduate Project				X		X				X	X	X
40	EEE453/4	7	Control System Design			X		X							

Legend

PO1- Engineering Knowledge
Ability to apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.

PO2- Problem Analysis
Ability to identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3- Design/Development of Solutions
Ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO4- Investigation
Ability to conduct investigation of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, synthesis of information to provide valid conclusion.

PO5-Modern Tool Usage
Ability to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.

PO6- The Engineer and Society
Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.

PO7- Environment and Sustainability
Ability to understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.

PO8 – Ethics
Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9- Individual and TeamWork
Ability to function effectively as an individual, and as a member or leader in teams and in multi-disciplinary settings.

PO10- Communication
Ability to communicate effectively on complex engineering activities with the 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.

PO11- Project Management and Finance
Ability to demonstrate knowledge and understanding of engineering and management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12- Life Long Learning
Ability to 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.

5.3 COURSE DESCRIPTION

EEE105/3 – Circuits Theory I

Objective: To study the main electrical components and electrical analysis methods for DC and AC electrical systems.

Synopsis: This course is teaching the fundamental of electric circuit and its analysis for DC and AC systems which comprises topics of Circuit Variables and Elements, Resistive Circuits, Techniques of Circuit Analysis, Inductors and Capacitors, Response of First-Order RL and RC Circuits and Sinusoidal Steady-State Analysis.

Circuit Variables and Elements
Review of circuit analysis, International System of Units (SI), voltage and current, power, energy, basic circuit elements (passive and active), voltage and current sources, Ohm's law, Kirchhoff's laws, circuit models, circuits with dependent sources.

Resistive Circuits
Resistors in series and parallel, voltage and current divider circuits, measuring voltage and current, the Wheatstone bridge, Delta-to-wye (Δ - Y) equivalent circuits.

Techniques of Circuit Analysis
Introduction to node-voltage method, node-voltage method with dependent sources and special cases, introduction to mesh current, mesh current method with dependent sources and special cases, source transformations, Thevenin and Norton equivalent circuits, maximum power transfer, superposition.

Inductors and Capacitors
Inductor, voltage and current relationships, power and energy. Capacitor, voltage and current relationships, power and energy. Series and parallel combinations of inductance and capacitence.

Response of First-Order RL and RC Circuits
Natural response of RL anf RC circuits, step (forcing) response of RL and RC circuits, a general solution for natural and step responses, sequential switching, introduction to nutural and step responses of RLC circuits.

Sinusoidal Steady-State Analysis
Sinusoidal source, sinusoidal response, concept of phasor and phasor diagram, passive circuit elements in frequency domain (V-I relations for R, L and C), impedance and reactance, Kirchhoff's laws in frequency domain, circuit analysis techniques in frequency domains.

Sinusoidal Steady-State Power Calculations
Instantaneous power, average (active) and reactive power, the rms valve and power calculations, complex power and power triangle, impedance and maximum power transfer

Power System Circuits
Single-phase and three-phase (Y and Δ) systems, balanced three-phase voltage sources, analysis of Y-Y and Y - Δ circuits, power calculations in balanced three-phase circuits, measuring average power in three-phase circuits.

Course Outcomes:
CO1: Be able to define, explain and analyze the basic laws, methods and circuit theorems in DC circuit analysis
CO2: Be able to define, explain and analyze the basic laws, methods and circuit theorems in AC circuit analysis.

References:

1. Alexander C. K. & Sadiku M. N. O. "Fundamentals of Electric Circuits", 6th edition, McGraw-Hill, Boston, (2017).
2. Nilsson and Riedel, "Electric Circuits", 9th Edition, Addison Wesley, Reading, Massachusetts, (2011).

EEE123/3 – Computer Programming for Engineers

Objective: This course aims to deliver the basic knowledge of C++ programming language as a preparation for students in using programming tools to solve engineering problems.

Synopsis: This course is fundamental not only to computer related subjects but also to other subjects that require complex calculations and computer simulations. It exposes students to the organization of computer, step-by-step procedures, programming terminologies and program commands that are required in solving engineering problems based on computer program using C++ programming language.

Introduction to Computer Organization and Programming
Computer organization, computer programming languages, and algorithms which include flowcharts and pseudocode.

Preprocessor Header Files and Identifiers
Types of preprocessor files and the inclusion of preprocessor files in a program. Rules to naming identifiers.

Declaring Data Types and Identifiers
Declaring variable types - character, integer, floating point numbers, and constants – with their defined identifiers.

C++ Statements
Arithmetic statements and expressions including operator types.

C++ Branching Structure
C++ expressions for branching and conditional branching using if-else, and switch-case.

C++ Repetition Structure
Repetition structure using while, do-whileand for.

Functions and Program Control Flow
Use of functions including function arguments, parameters, call by reference, call by value, and recursion, involving the understanding of program control flow.

Arrays
Array indices, cells, character strings, one-dimensional arrays and multi- dimensional arrays.

Pointers
Pointer variables, pointer levels and arrays, pointer reference function calls.

Structure and Unions
Structures and operations on structures.

File Input/Output
High-level input/output using files and format.

Course Outcomes:

CO1: Able to understand a problem and identify inputs and outputs

CO2: Able to analyse a problem and formulate step-by-step procedures in solving the problem

CO3: Able to write a complete C++ program in correct process flow to solve a given problems

References: 1. Diane Zak, "An Introduction to Programming With C++", 8th edition, Cengage Learning, (2015)

2. Y. Daniel Liang, "Introduction to Programming With C++", 3rd edition, Pearson Education Limited, (2014)

EUM113/3 - Engineering Calculus

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

Synopsis: This course reviews the topics on calculus of one and multivariable. It also covers the topics of solutions of ordinary differential using analytical and numerical methods.

Calculus of One Variable

Concept of Function: domain and range, limit and continuity, L'Hopital Rule.

Differentiation: mean theorem concept, techniques of solutions and applications.

Integration: Riemann sum concept, techniques of solutions and applications.

Solution of Numerical Method
Newton Raphson, Simpson

Calculus of Multivariable

Multivariable Function: scalar and vector, operator with vector function, limits and continuity.

Partial Differentiation: chain rule, derivatives differential and vector slope, maximum and minimum values, Lagrange multiplier.
Multiple Integration: Double integration and its application, triple integration and its applications, change of variables in multiple integration.

Ordinary Differential Equations

Solution of First Order ODE: separation of variables, linear, Bernoulli, exact, non exact, homogenous, non homogenous.

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

Course Outcomes:

CO1: Able to define the concept and solve the problem of one and multivariable calculus

CO2: Able to define the concept of ODE and recognize different methods for solving ODE

C03: Able to use analytical and numerical methods to solve ODE

CO4: Able to apply the above concepts for solving engineering problem.

References:

1. Glyn J., (2010).Modern Engineering Mathematics, 4th Edition. Pearson.
2. Glyn, J., (2010).Advanced Modern Engineering Mathematics, 4th Edition. Pearson
3. Silvanum P.Thompson, Martin Gardner (2008). Calculas Made Easy, Enlarge Edition, Johnston Press.
4. J.N.Sharma (2007). Numerical Method for Engineers, 2nd Edition, Alpha Science.
5. Smith R. T. and Minton, R. (2008). Calculus, 3rd Edition, Mc Graw Hill.
6. Ramana, B.V. (2007). Higher Engineering Mathematics, 1st Edition, Tata Mc Graw Hill.
7. O'Neil, P.V. (2007). Advanced Modern Engineering Mathematics, 1st Edition.
8. Kreiyzig, E. (2010). Advanced Engineering Mathematics, 10th Edition,Wiley, Thomson.
9. Stroud, K.A, Dexter. J. Booth (2007). Engineering Mathematics, 6th. Edition, Industrial Press.
10. James Stewart (2011). Calculus,7th Edition, Brooks Cole.
11. James Stewart (2011). Multivariable Calculus, 7th Edition, Brooks Cole.
12. Ron Larson,Bruce H. Edwards (2009). Calculus, 9th Edition. Brook Cole.

13. Steven Chapra, Raymond Canale (2009). Numerical Method for Engineers, 6th Edition. Mc Graw Hill.
14. D.Vaughan Griffith, I.M Smith (2006). Numerical Method for Engineers, 2nd Edition, Chapman and Hall.

EEE125/3 – Basic Circuit Laboratory

Objective: Students will be able to see the practical implementation of the circuit and electronic device theories that were taught to them previously. Practical means that the circuits that the students study are made up of actual electronic components. Students will also learn the practical skills required to design and troubleshoot actual electronic circuitries.

Synopsis: This course comprises of 15 experiments that will be conducted by the students. The experiments are on multimeter applications, the measurement of voltage, current and resistance in a dc circuit, oscilloscope and function generator, transformer, capacitor, inductor and power measurement in ac circuits, superposition, Thevenin and Norton theorems, diode in series and parallel configuration, to analyze and study the characteristic of BJT.

Course Outcomes:
CO1: Able to prepare and use the appropriate basic laboratory equipment for conducting circuit analysis according to common engineering practice
CO2: Able to identify, demonstrate and measure the various types of electronic circuit with correct practice for valid outcome.
CO3: Able to measure, define and describe the characteristics of several passive and active components using standard circuit analysis.

References:
1. En Ahmad Nazri Ali, Dr Aftanasar Md Sahar, PM Dr Norlaili Mohd Noh, Dr Mohd Adzhar Md Zawawi, Dr Nur Syazreen Ahmad, , "Laboratory manual EEE125:Basic Circuit lab semester:Academic year 2015/2016".
2. Nilsson and Riedel (2015), "Electric Circuit", 10th Edition, Pearson
3. Alexander Sadiku (2013), " Fundamentals of Electric circuits", 5th Edition, McGraw Hill.
4. Robert L. Boleystad (2009), " Electronic devices and circuit theory", 10th Edition, Pearson

EEE 130/3 – Digital Electronics I

Objective: To introduce digital electronic systems, major devices, combinational and sequential circuits.

Synopsis: This course covers digital electronic systems, major logic devices and combination and sequential logic circuits.

Introduction
Digital and analog quantities, logic levels and digital waveforms.

Number Systems, Operations and Codes
Binary numbersm binary arithmetic and conversion, signed numbers, hex, octal, BCD, parity.

Logic Gates and Circuits
NOT, AND, OR, NAND, NOR, XOR, XNOR, truth table and timing diagram.

Boolean Algebra and Logic Simplification
Laws and rules of Boolean algebra, DeMorgan's theorem, logic simplication, forms of Boolean expressions, Karnaugh map.

Combination Circuits Design
Implementing combinational logic, adders, comparators, decoders, encoders, multiplexers, demultiplexers, parity generators and code converters.

Memory Devices
Latches, Flip-flops, timing phase characteristics, applications.

Sequential Circuits Design
Synchronous counters, asynchronous counters, counter design, counter decoding, shift registers and applications.

Course Outcomes:
CO1: To be able to explain the concepts, design and analyze combinational logic circuits
CO2: To be able to explain the concepts, design and analyze sequential logic circuits

References:
1. Floyd, T.L., "Digital Fundamentals", 11th ed., Pearson, (2015).
2. Tocci, R.J., Widmer, N., and Moss G., "Digital Systems: Principles and Applications", 11th Ed, Prentice Hall, (2010).

EEE133/3 – Electronic Devices and Circuit

Objective: 1. To give understanding on how current flows through the p-n junction and relating this phenomena to the characteristics and operation of the diodes, bipolar and field-effect transistors.

2. To give understanding on the function and application of the diodes, bipolar junction and field effect transistors in electronic circuits.

Synopsis: This course provides knowledge on semiconductor material and PN junction, diode and its application, operation and biasing techniques for Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET).

Semiconductor Material and P-N Junction
Conduction in semiconductor (current carriers, mobility, drift velocity, mean free path, lifetime of charge carriers, conductivity, resistivity, charge density, current density, drift and diffusion currents), Silicon and Germanium semiconductors, intrinsic and extrinsic semiconductors, Fermi Dirac function and Fermi level, Hall Effect, p-n junction and current components in p-n junction, p-n junction biasing and current-voltage characteristic.

Diode and its Applications
Piecewise linear diode model, rectifying diodes, half-wave and full-wave rectifiers, rectifier-filter circuit, clipping and clamping diode circuits, special purpose diodes : zener diode, LED, tunnel diode, photo diode, laser diode, varactor diode, Schottky diode.

Bipolar Junction Transistor (BJT)
Transistor structure, transistor basic operation, transistor parameters and rating, transistor as an amplifier, transistor as a switch, transistor configurations (CB, CE, CC), BJT input and output characteristics.

BJT biasing
Load line, Q point/dc biasing point, base/fixed current biasing, collector feedback/collector-base biasing, voltage-divider biasing. BJT low frequency small signal models : hybrid- model and r-parameter model / T model.

Field Effect Transistor (FET) and Biasing
Junction Field Effect Transistor (JFET) : JFET basic operation, JFET characteristics and parameters, JFET biasing : fixed biasing, self biasing, midpoint biasing, voltage-divider biasing. MOSFET (DE MOSFET and E MOSFET) operations, MOSFET characteristics and parameters, MOSFET biasing : zero biasing, drain feedback biasing, voltage-divider biasing.

Course Outcomes:
CO1: Able to describe, explain and analyse the characteristic features of semiconductor physics qualitatively and quantitatively
CO2: Able to describe, explain and analyse the characteristic features of diodes and their application in the electronic circuits
CO3: Able to describe, explain and analyse the characteristic features of BJTs and its DC biasing
CO4: Able to describe, explain and analyse the characteristic features of FETs and its DC biasing

References:

1. Boylestad, R.L., Nashelsky, L., "Electronic Devices And Circuit Theory", 11th Edition, Prentice-Hall, (2013).
2. Floyd, T., "Electronic Devices," Electron Flow Version, 9th. Edition, Prentice Hall, (2012).
3. Neamen, D. A., "Semiconductor Physics and Devices-Basic Principles", 4th Edition, McGraw Hill, (2011).
4. Sze S.M., Ng, K. K., "Physics of Semiconductor Devices", 3rd Edition, John Wiley, (2007).

EEL102/2 - Engineering Practices

Objective: This course is an introduction to basic mechanical machines and processes, electronic components, devices and instruments, electrical wiring, power supply circuit, design software package such as ORCAD and basic PCB. This course will not only introduce the students to the hardware side of electronics but will also expose them to computer tools that can assist them in the learning process by providing a visual representation of a circuit's behaviour and validating a calculated solution. This computational support is often invaluable in the electronic design process.

Synopsis: This course is divided into three components. The components are on the skill and technique on how to use PSpice and Or CAD software in simulation and design the electrical and electronic circuitry and fabrication technique for Printed Circuit Board (PCB). Domestic wiring and basic welding process are exposed to equip students with fundamental engineering skill.

Course Outcomes:
CO1: Able to describe and explain basic operation of Pspice/Orcad and techniques employed in PCB fabrication
CO2: Able to describe and explain basic techniques employed in electrical wiring and mechanical engineering

References:
1. Joseph G. Tront (2005). Pspice for Basic Circuit Analysis, 2nd Edition, McGraw Hill.
2. Alexander Sadiku (2013). "Fundamentals of Electric Circuits, 5th Edition, McGraw Hill.

EUM114/3 - Advanced Engineering Calculus

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

Synopsis: This course covers the topics on linear algebra, Fourier series, partial differential equations, and vector calculus. Numerical techniques for solving systems of linear equations and partial differential equations are also given.

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

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

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

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

Course Outcomes:
CO1: To define the concept of fourier series and to solve Fourier Series Problems
CO2: To recognize the types of partial differential equation (PDE) and to solve the equations analytically and numerically
CO3: To use the vector fundamental operations in order to solve Vector Calculus problems
CO4: To solve Linear Algebra problems analytically and numerically

References:

1. Ahmad Shukri Yahaya, et al., Advanced Engineering Calculus for Engineers (2016), ISBN 978-967-0167-17-6
2. Glyn J., (2015). Modern Engineering Mathematics, 5th Edition. Pearson
3. Glyn, J., (2010). Advanced Modern Engineering Mathematics, 4th Edition .Pearson
4. Kreiyzig, E., (2010). Advanced Engineering Mathematics,10th Edition. Wiley.
5. Ramana,B.V (2008). Higher Engineering Mathematics, 4th Edition. Wiley.

.

6. Ron Larson, Bruce H. Edwards (2009). Calculus, 9th Edition. Brook Cole.
7. Chapra, Raymond Canale (2009). Numerical Method for Engineers, 6th Edition. Mc Graw Hill.

EEE208/3 – Circuit Theory II

Objective: To learn the techniques for analyzing electric circuits using the Laplace and Fourier Transform.

Synopsis: This course covers techniques for analyzing electrical circuits using Laplace and Fourier transforms. It also includes the topics of mutual inductance, frequency response for AC circuits, and two port circuits.

Mutual Inductance
A Review of Self-Inductance, the concept of mutual inductance, the polarity of mutually induced voltages (the dot convention), energy calculations, the linear and ideal transformer, equivalent circuits for magnetically coupled coils, ideal transformers equivalent circuits.

Introduction to the Laplace Transform
Definition of the Laplace transform, the step function, the impulse function, functional transforms, inverse transform, poles and zeros of F(s), initial and final value theorem.

The Laplace Transform in Circuit Analysis
Circuit elements in the S domain, circuit analysis in the S domain, the transfer function, the transfer function in partial fraction expansions, the transfer function and the convolution integral, the transfer function and the steady-state sinusoidal response, the impulse function in circuit analysis.

Frequency Response for AC Circuits

Frequency response (magnitude plot and phase, pass-band, stop-band), cut-off frequency, typical filter, RL and RC low-pass filter, RL and RC high pass-filter, band-pass filter RLC (resonance frequency, bandwidth, Q factor), stop-band filter RLC (resonance frequency, bandwidth, Q factor), frequency response using Bode diagram (complex poles and zeros).

Fourir Series

Overview of Fourier Series, the Fourier Coefficients, the effect of symmetry on the Fourier Coefficients, an alternative trigonometric form of the Fourier series, Fourier series analysis for first order circuits (RL and RC), average power calculations with periodic functions, the rms value of a periodic function, the exponential form of the Fourier series, amplitude and phase spectra.

The Fourier Transform

Derivation of the Fourier Transform, the convergence of the Fourier integral, relationship between Laplace and Fourier transform, Fourier transform in the limit, properties of Fourier transform, circuits analysis using Fourier transform, Parseval theorem and energy calculation involving spectrum magnitude.

Two-Port Circuits

The terminal equations, the two-port parameters (**z**, **y**. **h**, **g**, **T**, **t**), relationship amongst two-port parameters, analysis of the two-port circuits with load (such as Z_{in}, I_2, V_{Th}, Z_{Th}), relationship among two-port circuits (cascade, series, parallel, series-parallel, parallel-series).

Course Outcomes:

CO1: To investigate and apply circuit analysis techniques to solve complex circuit problems.

CO2: To analyze and evaluate complex circuit problems, the solution techniques and their solutions.

References:

1. Alexander, C. and Sadiku, M., "Fundamentals of Electric Circuits", 6th Edition, McGraw Hill, (2016).
2. Nilsson, J., and Riedel, S., "Electric Circuits", 10th Edition, Pearson, (2014).
3. Svoboda, A., and Dorf, R., "Introduction To Electric Circuits", 9th Edition, Wiley, (2013).

EEE226/3 Microprocessor I

Objective: Study on microprocessor/microcontroller system architecture and programming assembly language.

Synopsis : Introducing fudamental architecture and programming of microprocessor and microcontroller. That understanding can be used to build a simple application using the microprocessor and microcontroller.

Introduction
Fundamental microprocessor/microcontroller system, types of microprocessor/ microcontroller, memory subsystem, programming.

Internal Microprocessor/ Microcontroller Architecture
CPU structure, data bus, address and control, register, I/O, interrupt, stack, I/O and memory addressing, instruction set and address mode, timing and instruction implementation.

I/O Operation
Controlled programming I/O, interrupt, priority interrupt, digital data input and monitoring.

Input and Output Data Analog
Analog to digital signal conversion and vice versa, sampling theory, analog to digital converter, digital to analog converter.

Laboratory
Microprocessor/ microcontroller laboratory cover all the above topics.

Course Outcomes:
CO1: To explain the microprocessor architecture
CO2: To interface microprocessor/ microcontroller using assembly language.
CO3: To interface I/O devices witk microprocessors/microcontroller

References:

1. Krishnan Kant, (2014). Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096
2. Routt W., (2007). Microprocessor Architecture, Programming and System Featuring the 8085. Thomson Delmar Learning
3. Mano M. M. and Kime C. R., (2004). Logic and Computer Design Fundamentals, 3rd Edition. Pearson, Prentice Hall
4. Mazidi M. A. and Mazidi J. G., (2003). The 80x86 IBM PC and Compatible Computers. Vol. I and II. Assembly Language, Design and Interfacing, 4th Edition. Pearson, Prentice Hall

5. Gaonkar R. S., (2002). Miroprocessor Architecture, Programming and Applications with the 8085, 5th Edition. Pearson
6. Gilmore C. M., (1995). Miroprocessors: Principles and Applications, 2nd Edition. Mc Graw Hill

EEE228/3 – Signals and Systems

Objective: To provide a common background for subsequent courses in control, communication, electronic circuits, filter design, and digital signal processing

Synopsis: This subject gives exposure to students to learn the fundamental of signals and systems from mathematical modeling, analyses methods of analog and digital systems, sampling and modulation processes. In addition, this course also covers the knowledge, analyses and the applications of Fourier systems and Z transform.

Introduction to Signals
Classification of signals, some useful signal models, basic operations on signals, elementary signals, representation of signals using impulse functions.

Introduction To Continous-Time Systems
Classification of continuous time systems, properties of linear time invariant (LTI) systems. System representation by differential equations. Impulse response and convolution integral.

Time-Domain Analysis of Continous-Time Systems
Fourier series: different forms, properties, application, response of LTI systems to periodic inputs Fourier transformation: properties, system transfer function, applications of Fourier transform in system analysis

Discrete time signals & systems
Useful discrete-time signals and operations, discrete time systems, representation of discrete time periodic signals, Discrete-time Fourier transform (DTFT), properties of DTFT, Fourier transform of sampled continuous time signal

Z-Transform
Convergence of Z-transform, Properties of Z-transform, Discrete-time system analysis using the Z-transform

Course Outcomes:

CO1: To be able to interpret and analyze signals in both time domain (countinuous and discrete) and frequency domain

CO2: To be able to utilize knowledge on continuous time systems to model an LTIC system, analyze and interpret the system properties

CO3: To be able to explain and apply knowledge of Fourier analysis

CO4: To be able to explain and utilize knowledge of z –transform

References:

1. Philips C.L., & Parr, J.M., Riskin, E.A. "Signals, Systems and Transforms", Pearson Prentice Hall, 5th Edition, (2014).
2. Kamen, E. W and Heck, B.S, "Fundamental of Signal and Systems Using the Web and MATLAB", 3rd Edition, (2014).
3. P. Ramakrishna Rao, "Signal and Systems", McGraw Hill, (2013).
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, (2008).

EEE231/3 – Digital Electronics Laboratory

Objective: To enable students to have better understanding on the fundamentals of the basic digital electronics from practical implementation.

Synopsis: The course (lab) is divided into 2 modules which are based on the course EEE130 – Digital Electronic I. The first module concentrates on the basic of digital electronics which includes Logic Gate ICs and troubleshooting, Counters, Multiplexers, Flip-Flop, Triggers, Registers and Combinational Logic. The outcome of the first module is to enable students to understand and design simple and basic digital circuits. The knowledge will then be used in the second module where students will be given the tasks on designing more complex combinational and sequential circuits.

Course Outcomes:

CO1: able to identify and apply basic digital electronic components and circuits

CO2: able to analyse problems in digital circuits

CO3: able to exhibit design output in the form of report and provide relevant detailing

References:

1. Floyd, T.L., "Digital Fundamentals", 11th ed., Pearson Education Ltd., (2015).
2. Tocci, R.J., Widmer, N., and Moss G., "Digital Systems: Principles and Applications", 11th Ed., Prentice Hall, (2010).

EEE232/3 – Complex Analysis

Objective: This course reviews the topics on complexs number, comnplex function, analytic function, complex differentiation and integration, conformal mapping and application in potential theory.

Synopsis: This course reviews the topics on complex number, complex function, analytic function, complex differentiation and integration, conformal mapping and application in potential theory.

Complex number and the complex plane
Polar form of complex number, Power and roots, Applications

Elementary functions
Complex power, Exponential and logarithm function, Trigonometric and Hyperbolic function, Applications

Analytic functions
Differentiability and Analytically, Cauchy-Riemann Equation, Harmonic function, Application

The Complex Integral
Line Integral in Complex Plane, Cauchy's Integral Theorem and Cauchy's Integral Formula, Application

Series and Residues
Complex Series and Taylor Series, Laurent Series, Classifications of singularities, Residue Theorem, Applications

Conformal Mapping
Geometry of Analytic Function: Conformal Mapping, Linear Fractional Transformations, Special Linear Fractional Transformations, Conformal Mapping by Other Functions Applications.

Course Outcomes:

CO1: To identify method of solving problems related to complex numbers and complex planes as well as problems related to the elementary functions such as exponential and logarithmic and their usage

CO2: To identify method of evaluating analytical function, harmonic function and complex integration and to be able to use the related formula and theorem involved.

CO3: To state and explain the concept of conformal mapping and its application in potential theories

References:
1. K. Stroud (2013). Engineering Mathematics 7th Edition, Industrial Press Inc., USA.
2. Glyn James (2011). Advanced Modern Engineering Mathematics 4th Edition. Pearson Education Limited, United Kingdom.
3. Erwin Kreyszig (2011). Advanced Engineering Mathematics 10th Edition. John Wiley & Sons, USA.

EEE241/3 – Analogue Electronics I

Objective: To learn analogue electronic amplifier circuits and devices

Synopsis: This course emphasizes on the analysis of amplifiers.

Small-signal of BJT Amplifiers
Small-signal model, ac and dc equivalent circuit, common-emitter, common-collector and common-base configurations.

Small-signal of FET Amplifiers
Small-signal model, ac and dc equivalent circuit, common-source, common-drain and common-gate configurations.

Multi-stage Amplifiers
Cascade amplifiers

Operational Amplifiers
Basic op-amp operation

Large-signal Amplifier
Operation and circuits of class A, class B, class C and class D amplifiers, push-pull amplifiers.

Frequency Response
Basic concepts of Miller's theorem, decibel, low-frequency response, high-frequency response, and complete frequency response.

Circuit Simulation using PSPICE

Course Outcomes
- CO1: Be able to define the small signal models for single stage and multistage amplifiers
- CO2: Be able to describe the small signal models for single stage and multistage amplifiers.
- CO3: Be able to illustrate the small signal models for single stage and multistage amplifiers.
- CO4: Be able to analyze the small signal models for single stage and multistage amplifiers

References: 1. Jaeger R. C. and Blalock T. N., Microelectronic Circuit Design, 5th Edition, McGraw Hill: New York, (2015).
2. Sedra A. S., Smith K. C., Microelectronic Circuits, 7th edition, Oxford University Press, (2014).

EEE243/3 - Analogue Electronics Laboratory

Objective: To conduct experiments on analogue circuits.

Synopsis: This course comprises of 14 experiments that will be conducted by the students. The experiments are on Diode, BJT, FET, Op-amp, Power Amplifier, filters and rectifiers as well as their applications

Course Outcomes:
CO1: To be able to simulate, conduct and compare the operations of transistors through circuit analysis, deductions based on observations and writing reports.
CO2: To be able to simulate, conduct and compare the operation of amplifier through circuit analysis, deductions based on observations and writing reports
CO3: To be able to simulate, conduct and compare the operation of filters and rectifier through circuit analysis, deductions based on observations and writing reports
CO4: To be able to apply the knowledge on analogue circuits into its applications through circuit analysis, deductions based on observations and writing reports

References:
1. Dr. Mohd Tafir Mustaffa, Dr Widad Ismail, Dr Mohd Fadzli Mohd Salleh, Dr Mohd Ansor Yusoff dan En. Zulfiqar Ali Abd Aziz. Laboratory Manual EEE 243: Analogue Electronics Laboratory, (2010/2011).
2. Robert L. Boleystad (2012). Electronic Devices and Circuit Theory, 11th Edition.
3. Thomas L. Floyd (2012). Electronic Devices, 9th Edition, Pearson Education.
4. Sedra and Smith. (2014) Microelectronic Circuits, Oxford, 7th Edition.

EEE270/3 – Analogue Electronics II

Objective: To prepare the students a basic understanding of device operation, model and analysis, and the design approach commonly used and to provide the students with necessary understanding for future microelectronics circuit design and analysis problems.

Synopsis: This course emphasizes on the analysis and design of amplifiers and its frequency response.

Operational Amplifier (Op-Amp):
Ideal and Non-ideal Op-Amp, differential amplifier, common mode, op-amp parameters, basic op-amp circuits, practical op-amp, op-amp data sheet.

Op-Amp Circuits Applications
Summer, buffer, comparator, integrator, differentiator circuits, switch capacitor, rectifies

Feedback Circuits
Feedback concept, types of feedback connection, practical feedback circuits.

Oscillator Circuits
Basic operations, Phase shift, Wien bridge, Crystal oscillator.

Active Filters and Its Frequency Response
Basic filter, Filter response characteristics, Low-pass filter, High-pass filter, Notch-pass filter, Band-pass filter, Measurement of filter response, Filter design: Butterworth, Chebychev and Elliptic.

High Frequency Amplifier Circuit and Its Frequency Response
Gain, Input and output impedance, Mliller's effect, transfer functions of amplifier circuits and noise in amplifier circuits.

Multistage Amplifier Circuit and Its Frequency Response
Cascode configuration, OTA, differential amplifier, gain and phase margin of multistage amplifer circuits, CMRR, Mliller's effect and noise in amplifier circuits.

Circuit Simulation using PSPICE

Course Outcomes:

CO1: To be able to define and explain the design of amplifier circuit and its frequency response

CO2: To be able to demonstrate the design of amplifier circuit and its frequency response

CO3: To be able to analyse the design of amplifier circuit and its frequency response

CO4: To be able to design amplifier circuit and its frequency response

References:

1. Jaeger R. C. and Blalock T. N., Microelectronic Circuit Design, 5th Edition, McGraw Hill: New York, (2015).
2. Sedra A. S., Smith K. C., Microelectronic Circuits, 7th edition, Oxford University Press, (2014).

EEE276/3 – Electromagnetic Theory

Objective: In this course students learn the theory and analysis of the electromagnetic fields and transmission lines.

Synopsis: This course deals with the theory and analysis on electromagnetic for electrostatics, magnetostatics and dynamic (time varying). It also covers properties of plane wave propagation and electromagnetics application in system design.

Vector Analysis (Review)

Vector and scalar quantities, Gradients, Curls, Laplacian, Divergiences and Stoke's law.

Electrostatic Fields

Basic Laws: Coulomb, Gauss, Electric flux density, Electric field intensity, and Electric potential. Laplace and Poisson equations, boundary's conditions, Electrostatics field in dielectric materials, Capacitance. Energy in electrostatic fields. Magnetostatic Fields Biot-Savart's law, Ampere's law, magnetic flux density, magnetic field intensity and magnetic pontential, boundary's conditions.

Plane-Wave Propagation

Time harmonic fileds, plane-wave propagations in lossless media, Wave polarization, Plane wave propagation in lossy media, current flow in good conductor, electromagnetic power density

Course Outcomes:

CO1: To be able to define, identify and describe vector algebra and calculus in solving electromagnetic problems

CO2: To be able to define, identify, describe electromagnetic fields for electrostatics, steady current, magnetostatics and time varying conditions in solving electromagnetic problems

CO3: To be able to interpret, apply, develop and calculate electromagnetic fields for electrostatics, steady current, magnetostatics and time-varying conditions in solving electromagnetics problems

CO4: To be able to analyze, compare, differentiate and classify electromagnetic problems based on electrostatics, steady current, magnetostatics, and time varying field using Maxwell's equations

References:

1. Fundamentals of Applied Electromagnetics (7^{th}. Edition); Author: Fawwaz T. Ulaby, Umberto Ravaioli (2016), Publisher: Pearson Education
2. Elements of Electromagnetics; 4^{th} edition, Author: MathewN.O.Sadiku (2007), Publisher: Oxford University Press.
3. Electromagnetics with Application; 5th edition, Author John D. Kraus and Daniel A. Fleisch (1999), Publisher: McGraw-Hill.

EEE320/3- Microprocessors II

Objective: To explain development of embedded system using microprocessor/ microcontroller.

Synopsis: Introducing fundamental architecture, programming and interfacing of microprocessor/microcontroller with external devices. Basic knowledge acquired will enable students to build simple applications of embedded systems.

Microprocessor/Microcontroller

Detailed architecture of typical 8, 16 and 32 bit microprocessor/ microcontroller assembely language programming for 8086, I/O interfacing.

Embedded System Design

CPU requirements, microprocessor/microcontroller architecture and applications, embedded microprocessor concept, DSP and embedded PC.

High Reliability Design

EMI Problems, ESD, grounding, noise, power supply, PCB design, compliance.

32 bit ARM Processor
Architecture, instruction set, RISC, organization and implementation, pipeline organization.

Laboratory
Programming Microprocessor 8086 using assembly and high level language.

Course Outcomes:
CO1: Identify needs, analyze and develop programming for microprocessor/microcontroller.
CO2: Understanding how to connect I/O with microprocessor / microcontroller.
CO3: Build a basic application of embedded system using microprocessor / microcontroller

References:

1. Brey B.B. (2006). The Intel Microprocessor 8086/8088, 80186, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium IV – Architecture, Programming and Interfacing, 7th Edition, Pearson, Prentice Hall.
2. Mazidi A. M. and Mazidi J.G. (2003). The 80x86 and Compitible Computers (Vol. 1 and II), 4th Edition, Prentice Hall.
3. https://www.altera.com/content/dam/altera www/global/en_US/pdfs/literature/tt/tt_qsys_intro.pdf
4. http://www.nuvoton.com/resource-files/DA00-NUC140ENF1.pdf

EEL303/5 - Industrial Training

Objective: Placing the students in various electrical and elctronics industrial sectors in order to provide practical exposure to real engineering working environments. Students will be trained in various aspects, such as to analyse, to design, management and economy related to engineering carrier as an engineer.

Course Outcomes:
CO1: Adapt to actual working environment after graduation
CO2: Apply knowledge, skills and abilities acquired in USM for personal developments and career growth
CO3: Enhance knowledge and skills (particularly soft skills) with a particular organization
CO4: Aware of the current industrial trend

EEE322/4 – Microwaves & RF Engineering

Objective: To introduce the basic RF concepts, components and circuits such as lumped components, distributed components, power dividers, couplers, filters, amplifiers, mixers and oscillators.

Synopsis This course provides the introduction, comprehension, application and analysis of RF and Microwave Concept and uses S-parameter Network and other networks. It also includes the introduction on understanding and design of transistor circuit and passive components, filters, amplifiers and microwave source and mixers.

S-parameter
Circuit analysis using S-parameters

Microwave Devices and Passive Components
Transmission line: microstripline/stripline, terminators, attenuators, phase shifters, directional couplers, hybrid branch, power dividers, Faraday rotation, circulators, Isolators, SAW devices and resonators.

Filters
Design of filters using image parameter method, insertion loss method, filter transformation, microstripline filter, narrowband filter, lowpass filter, bandpass filter and bandstop filters.

Microwave Sources and Mixer
Klystron, Magnetron, Travelling wave tubes, Gunn diode, IMPATT diode, TRAPPATT diode, mixer

Amplifier Design
Bipolar transistor, FET, biasing, stability, low noise amplifier

Oscillator Design
One port negative resistance oscillator, Transistor oscillator, dielectric resonator oscillator, noise in oscillator.

Course Outcomes:

CO1: To be able to design and analyze an engineering-solution for complex engineering design on system, modules or components with effective methods and practical awareness in RF engineering process

CO2: To be able to reason through selecting and organizing data, tools and technique effectively, logically and correctly, displayed in complex graphical/statistical format, data sheet and/or media, during complex analytical, sustainable-design solution or scientific-engineering situation

References: 1. Microwave Engineering, David M.Pozar,John Miley and Sons, (2012) (4^{th}-edition)
2. Microwave Engineering, R.S.Rao, PHI Learning Pvt. Ltd. (2012)
3. Microwave Engineering, Annapurna Das, Sisir K Das, McGraw-Hill Education (2012)
4. The Microwave Engineering Handbook V3: Microwave systems and application, B. Smith, M.H.Carpentier, Springer (2012)

EEE332/4 – Communications

Objective: To learn communication systems, communication channels, modulation techniques, information theory and coding.

Synopsis: **Introduction to Information Transmission**
Analogue and digital systems modeling including information sources, transmitter, communication receiver channels and information sink. Information Sources characteristic such as audio, video, computer data, static materials, etc. and communication channels characteristic including noises, interferences and distortions.

Communication Channels Concept
Telephone lines or free space. Bandwidths' distribution and limitation in telephone lines or free space. Communication system modeling compared to existing communication systems such as telegraphy, telephony, radio, TV, facsimile, videotext dan komputer.

Modulation Techniques
Purpose of modulation, Linear modulations such as AM, DSBSC, SSBSC, VSB. Phase modulations such as FM and PM. Advantages of FM compared to AM. Generation and demodulation of AM and FM.

Noises in Communications
Noises and their effect on communication systems. Type of Noises : shot noise, thermal noise and white noise. Noise temperature and noises in linear networks: noise figure and noise measurement in dB.

Introduction to Data Transmissions
Advantages of digital communication systems. Sampling theorem, aliasing. Pulse code modulation: □- and A- law. Multiplexing: TDM, FDM, PAM, PWM, PVM and cross-talk. Representation of various types of binary signals: unipolar, dipolar, AMI, RZ and NRZ; peak and average power, Spectrum details, Detection of baseband signals in Gaussian noise: bit error rate using ideal filters. Random pseudo-noise characteristic and applications.

Optimum Receiver
Optimum filter concepts. Matched filter and correlation detection. Filters for synchronous digital systems, intersymbol interference, Nyquist filter thoerems, applications of cosine type filter and phasor diagram. Introduction to decision–making theory.

Information Theory and Coding
History and background. Information, entropy and joint and conditional entropies. Channel capacity, discrete and continous channel, Shannon- Hartley theorem, bandwidth and S/N.

Course Outcomes:
CO1: Able to identify and describe the basic principle of communication systems
CO2: To be able to calculate and explain principle of RF power measurement
CO3: Be able to define and explain the concept of analogue modulation.
CO4: Be able to define and explain the binary coding, digital modulation and multiplexing

References:

1. Wayne Tomani (1998). Electronic Communication Systems Fundamentals through Advanced, 3rd Edition, Prentice Hall.
2. William Schweber (1999). Electronic Communication Systems - A Complete Course, Prentice Hall.
3. Leon W. Couch II (1997). Digital and Analog Communication Systems, 5th Edition, Prentice Hall.
4. George Kennedy (1992). Electronic Communication Systems, 4th Edition, Mc.Graw Hill.

EEE344/4 – VLSI Systems

Objective: To learn methodologies in analysis and design of VLSI Circuits

Synopsis: This course reviews the basic principles to design and analysis VLSI system based on CMOS technology. It also covers the topics of structure and operation of MOS transistor, inverter, sequential and combinational logic circuit based on CMOS technology.

MOS Transistor
Structure of Metal Oxide Semiconductor (MOS), MOS System under external bias, structure and operation of MOS Transistor, MOSFET Current-Voltage Characteristics, MOSFET Scaling and Capacitances.

MOS Inverters: Static and Dynamic Characteristics
Static characteristics for Resistive load inverter, Depletion-load inverter, Saturated Enhancement-load inverter, CMOS Inverter. Delay-time definitions, Calculation of Delay times, Inverter Design with delay constraints, Switching power dissipation of CMOS inverters.

Combinational MOS Logic Circuits
MOS Logic with depletion-type nMOS loads, CMOS Logic circuits, Complex Logic circuits

Sequential MOS Logic Circuits
Behaviour of Bistable Elements, The SR Latch circuit, Clocked Latch and FF circuits, CMOS D-Latch and Edge Triggered FF. Sense-Amplifier-based FF, Power consumption of clocking system.

Dynamic Logic Circuits
Basic principle of Pass Transistor Circuits, Voltage bootstrapping, Synchronous dynamic circuit techniques, Dynamic CMOS circuit techniques.

Semiconductor Memories
Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Nonvolatile Memory, Flash Memory.

Course Outcomes:
CO1: To describe the structure and operation of MOS transistor including the relation between current and voltage of it and apply the knowledge of MOS transistor in designing various types of inverters
CO2: To analyze the static and dynamic operation of CMOS inverter, combinational and sequential circuits
CO3: To analyze the semiconductor memories and dynamic logic circuit

References:
1. Sung-Mo Kang, Yusuf Leblebici and Chulwoo Kim, (2015).CMOS Digital Integrated Circuits Analysis and Design, 4th Edition .McGraw Hill
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, (2003). Digital Integrated Circuits A design perspective, 2nd Edition .Prentice Hall

EEE348/3 – Introduction to Integrated Circuits Design

Objective: To learn the methodologies of analyzing and designing analogue and digital integrated circuits.

Synopsis: Intoduction
Introduction of Digital IC - History, semiconductor industries, evolution of Digital IC

IC Design Methodology
Digital IC Implementation Approaches:- Full custom based design, Standard Cells based design, FPGA based design

Operation and Fabrication of CMOS
Operation of MOS transistor and CMOS based logic gate; Fabrication of MOS Transistor and CMOS based logic gate

From Logic to Layout
Layout of digital IC - From logic to transistor, from transistor to layout; CMOS Layout, Stick Diagram, Layout verification

Semiconductor Memories
RAM, ROM

Method to design a digital IC using Verilog HDL
Digital system simulation, Basic concept of VHDL language, Characterization modeling, Structure modeling, Sequence processing, Type of Data, Sub-program, Package and Library, Basic Input/Output, Simulation and Synthesizing, Test bench in VHDL, VITAL application, CPU design and implementation of FPGA .

Course Outcomes:
CO1: Able to select and implement various methodologies on the design of digital integrated circuit using advanced tools to produce the optimized layout and correct functionality integrated circuit design
CO2: Able to understand and explain the operational principle of MOS transistor, the generic integrated circuit fabrication process as well as semiconconductor memories for basic application in microelectronic engineering
CO3: Able to apply the knowledge of Verilog HDL in designing a digital integrated circuit

References:

1. Sung-Mo Kang, Yusuf Leblebici (2005). CMOS Digital Integrated Circuits: Analysis and Design, McGraw Hill.
2. Neil H.E. Weste, David Harris (2005). CMOS VLSI Design: A Circuits and Systems Perspective, Pearson.
3. Yalamanchili, S. (1998). VHDL Starter's Guide, Prentice Hall.
4. Perry, D. (1998). VHDL, McGraw Hill.

EEE350/3 – Control Systems

Objective: To learn the mathematical modelling of physical systems controller design and analysis techniques.

Synopsis: The purpose of this course is to expose the students to transfer functions and mathematical model of physical systems. In addition, students will be exposed to knowledge on dynamics of open- and closed-loop systems in time and frequency domain, analysis techniques and feedback properties.

Introduction to fundamental concepts of control systems
An introduction to control systems, types and effects of feedback. Standard control loop with and without dynamics.

Differential Equations
Linear differential equations to model continuous system, Examples: electrical networks, mechanical systems

Laplace Transforms
Laplace transform definition, Examples: unit step, exponential function, sinusoid, dirac delta function. Laplace transform properties: linearity, differentiation, integration, delay and final value theorem.

Transfer Functions
Definition, Simulation, Block Diagrams and Closed-loop response, Sensitivity and Complementary Sensitivity, Stability.

Step Response Analysis.
Steady-state gain, First and Second Order Systems.

PID controller
Basic concept of PID controllers, PD controllers, PI controllers, PID controllers

Root Locus Techniques.
Root locus characteristics, stability via root locus.

Frequency Response Analysis.
Bode and Nyquist plots, stability analysis using gain margin & phase margin.

Course Outcomes:
CO1: Able to derive transfer function for a given system and investigate its dynamics such as stability and steady-state error.
CO2: Understand the feedback properties and able to design appropriate controllers to achieve required specifications.
CO3: Able to investigate and interpret the behaviour of the system via its time and frequency responses

References

1. Ogata, K., "Modern Control Engineering", 5th eds., Pearson, (2010).
2. Kuo, B.C., "Automatic Control System", 9th eds., John-Wiley, (2010).
3. Nise, N., "Control Systems Engineering", 5th eds, John-Wiley, (2008)
4. K.J. Åström and R.M. Murray. Feedback Systems; an introduction for scientists and engineers. Princetown University Press, (2008).

EEE 354/3 - Digital Control Systems

Objective: To study the principle of digital control system and its analytical techniques.

Synopsis: This course analyzes design techniques for digital control systems.

Introduction to Discrete-time Systems and Z-transform
Digital Control Systems, Control Problems, Discrete-time Systems, z-Transform Methods, Solution of Difference Equations, Simulation Diagram and Flow Graphs, Transfer Functions

Sampling and Reconstruction
Sampled-data Control Systems, Ideal Sampler, Data Reconstruction, Sharon's sampling theorem, Data-hold Model.

Open-loop System
Pulse Transfer Functions, Digital Filters, Modified z-Transform, System With Time Delay.

Closed-loop Systems
Basic concept, Transfer Function Derivation.

Time-response Characteristic
Time Response, Mapping of s-Plane to z-Plane, transient response, Steady-State Accuracy, Simulation.

Stability
Stability Concept, Bilinear Transformation, Routh-Hurwitz Criterion, Jury Stability Test, Root Locus, Nyquist Criterion, Bode Diagram, Frequency Response, Compensation through gain adjustment.

Application of MATLAB and SIMULINK

Course Outcomes:
CO1: To be able to apply the principles of data sampling, data reconstruction and discretization techniques to solve problems in digital systems analysis.
CO2: To be able to analyze open or closed loop digital system from characteristic equation and system time response characteristics.
CO3: To be able to analyze the stability of a digital system using frequency response techniques and stability tests

References:

1. Phillips, Nagle & Chakrabortty ; (2015) Digital Control System Analysis & Design, 4th Edition. Pearson
2. Ogata, K., (1995). Discrete-time Control Systems, 2nd Edition. Pearson.
3. Benjamin, C.K., (1992). Digital Control Systems, 2nd Edition, Oxford Press.

EEE355/4 – Robotic and Automation

Objective: To provide a fundamental course in understanding the basic robotic and automation set-up and approaches required in designing an automated industrial manufacturing line and also to expose the students to various components and supporting technology required, for example the mechanical system, sensory system and robot control.

Synopsis: This course aims to introduce students to the basic principles of robotics and automation systems, through exposure to basic concepts and components to both of these topics. The students, they will get an understanding for the process in designing an automation system which consists of a robotic system. Emphasis on robotic system is important because it is the primary system to a modern automation process. Exposure is also given to the selection and determination of key components for an efficient automation systems**,** via hardware and software approaches.

Introduction
Robot classification, Robot component, Automation, Economical consideration, Robot application

System Overview
Basic components, Robotic system, Function of robotic system, Robot specification

Mechanical Systems
Dynamic component, Modeling, Transformation and Kinematic Mechanical concept, Motion Transformation, Actual components, Mechanical system modeling, Kinematic analysis, End effector, Resolution, Repeatibility, Accuracy, Force, Lagrangian, Matrix transformation, and Jacobian.

Actuator Control
Position servo closed loop control, Friction and effect of gravity, Frequency domain, Robot arm control, Stepper motor, DC motor, Actuator, Pneumatic system and servo driver

Sensory Device
Non-Optical position sensor, Optical position sensor, Incremental encoder, Velocity sensor, Accelerometer, Proximity sensor, Tactile and Touch sensor, Force and Torque sensors.

Computer Vision
Vision components, Image representation, Hardware balance, Image encoding, Object recognition and Classification.

Computer Control System
Robot programming, Trajectory planning and Computer system.

Automation System
Automated System Design, Integration, Monitoring and Sensor Fusion

Course Outcomes:

CO1: To be able to describe the fundamental concepts in robotic manipulator in industrial automation applications
CO2: To be able to apply the appropriate components in robotic manipulator system development
CO3: To be able to design robotic manipulator according to the desired performance specifications
CO4: To be able to describe, apply, and design PLC based automation system

References:

1. Programmable logic controller, W Bolton, (5th Ed),Newnes, (2015)
2. Peter Corke, "Robotics, Vision and Control", Springer, (2013)
3. Tadej Bajd, Matjaz Mihelji, Marko Munih (2013), Introduction to Robotics, SPRINGER.
4. Spong, M.W., & Vidyasagar, M., (2006). Robot Modelling and Control, John Wiley.

5. Markus Vincze & Gregory D. Hager, Robust Vision for Vision-Based Control of Motion, Spie/IEEE Series, (2003)
6. Machine Vision, Algorithms and Application, Carsten Steger, Markus Ulrich, Christian Wiedemann, Wiley-VCH, (2008).
7. Craig, J. J. (1989). Introduction to Robotics, (2nd ed.), Prentice Hall.
8. Fu, K. S., Gonzalez, R. C., & Lee, C. S. G., (1987). Robotics: Control,Vision, and Intelligence, McGraw-Hill.
9. Fuller, J. L., (1999). Robotics: Introduction, Programming, and Projects, Prentice Hall.
10. Spong, M.W., & Vidyasagar, M., (1989). Robot Dynamics and Control, John Wiley.
11. Tsai, L.W., (1999). Robot analysis: The Mechanics of Serial and Parallel Manipulators, John Wiley.

EEE 377/4 – Digital Communications

Objective: To learn the analysis tools for digital baseband modulation techniques, modulation techniques, source and channel codings.

Synopsis: This course introduces the fundamental concepts of Parseval's power and energy theorem for analyzing the digital communication system signals between transmitter and receiver. Then, the course introduces the baseband transmission and receiving techniques. An analytical method called the probability of bit error and the concept of optimum receiver are introduced for analyzing the performance of the baseband receiver.
Then various passband modulation and demodulation techniques are introduced. The bandpass transmission signals are analyzed in term of the normalized power, and their performance is analyzed in term of probability of bit error. Finally, the concepts of the source and channel codings are presented for robust data transmission.

Signal Analysis tools for digital data transmission
Non-periodic signal baseband data transmission, average normalized power based on Parseval Theorem. Periodic signal baseband data transmission, *average* normalized power spectral density, normalized energy spectral density, and average normalized energy based on Parseval Theorem.

Digital Baseband Modulation Techniques
Pulse amplitude modulation (PAM) technique for limited channel transmission, pulse shaping, raised cosine and Inter-symbol Interference (ISI), receiver design, and derivation for probability of bit error (BER).

Digital Modulation Techniques
ASK, FSK, PSK, signal spectra and bit error rate. Equivalent binary PSK and DSBSC ASK. Introduction to m-ary systems such as PSK-4 and 8- phase. Generation and detection of PSK and realization of CPSK and DPSK, M-ary QA, M-ary FSK, Spread –spectrum modulation technique.

Detection/Receiver
Signal detection in Gaussian Noise Matched filter receiver, correlation detection, coherent detection, incoherent detection.

Source Coding
Shannon-Hartley data compression theorem and the effects. Coding without noise, removing redundancy and construction of Huffman code, Shannon- Fano coding

Channel Coding
Error control coding, types of error and code, techniques of controlling error. Hamming code and Hamming distance, Cylic code, convolution code– method of coding and decoding.

Course Outcomes:
CO1: Able to describe and utilize frequency domain mathematical tools in digital communication systems
CO2: Able to relate basic digital modulation techniques, source coding and channel coding schemes to solve digital communications problems
CO3: Able to perform in-depth analysis on any digital communication system with the knowledge obtained

References:

1. Simon Haykin and, Michael Moher, An Introduction to Analog and Digital Communications, 3rd Edition, John Wiley & Sons, (2016).
2. Harold P. E. Stern and Samy A. Mahmoud, Communication Systems Analysis and Design, Prentice Hall, (2004).
3. Bixio Rimoldi, Principles of Digital Communication: A Top-Down Approach, Cambridge University Press, (2016).
4. Simon Haykin, Digital Communication Systems, 1th Edition, John Wiley & Sons, (2013).

EEE 378/3 - Digital Electronics II

Objective: This course is a continuation from digital electronic course (EEE 130). The subject aims to provide an understanding of the formal procedure for analysis and design of combinational and sequential circuit. The concept of memories, programmable logic devices, sequencing and

control in computer architecture will also be introduced. Functional and hardware aspects in an integrated manner will be applied on FPGA using Verilog or VHDL language.

Synopsis: **Introduction to Digital System Representations**
Gates, Layout, FSM, HDL

Combinational System
Combinational System Specification, Combinational Integrated Circuit: Characteristics and Capabilities, Representation and Analysis of Gate Networks, Combinational System Design: Two-Layers and Multi-Layers

Sequential Systems
Sequential System Specifications, Sequential Networks

Combinational and Sequential Modules
Standard Combinational Modules, Combinational Arithmetic Modules and Networks, Standard Sequential Modules, Programmable Modules

Memory and Programmable Logic Devices (PLDs)
Definition of Memory, PLD and RAM, RAM Configuration, PAL/PLA, FPGA/CPLD

Transfer Register and Databus
Databus and Its Operation, Transfer Register Operations, Micro-Operations, Types of Transfers: Multiplexes, Bus, ALU, Shifter, Pipeline Databus

Sequencing and Control
Control Unit, ASM, Hardwired and Microprogramming Control, Simple Computer Architecture, Single Cycle and Multi-Cycles

Computer Organisation
Order Set Architecture, CPU Design, I/O Communication, Memory System, Specification and Implementation of Microcomputers

Project

Project uses FPGA devices such as Xilinx, Altera, which involves from schematic design to programming.

Course Outcomes:

CO1: To be able to systematically examine and analyze the combinational nature of digital logic in order to explain and interpret the functionality of digital electronic systems.

CO2: To be able to systematically examine and analyze the sequential nature of digital logic in order to explain and interpret the functionality of digital electronic systems.

CO3: To be able to design a complete digital system as a component in a mini project using VHDL and / or SPLD.

References:

1. Mano, M.M., and Kime, C.R. (2013). Logic and Computer Design Fundamentals, 4th Edition, Pearson.
2. Stephen Brown and Zvonko Vranesic (2008). Fundamentals of Digital Logic with Verilog Design, Mc Graw Hill.
3. Thomas L. Floyd (2009). Digital Fundamentals, 10th Edition Pearson.
4. Stephen Brown and Zvonko Vranesi (2005). Fundamentals of Digital Logic with VHDL Design, 2nd Edition, McGraw Hill.

EEE379/3 – Computer Systems And Multimedia

Objective: This course provides students with the knowledge of computer system organization and architecture. It also introduces students to the implementation of multimedia system.

Synopsis: This course introduces students to the fundamental concepts of personal computer architecture, computer performance, memory system, input/output, operating system, processor structure and function, parallel architecture, multimedia components and the applications of multimedia.

Personal Computer Architecture:
Central Processing Unit (CPU), high performance microprocessor (32/64 bit superscalar), bus structures, Peripheral Component Interconnect (PCI) bus specifications.

Computer Performance:
Execution time, performance ratio, speed-up, CPU time, Millions-Instruction-Per-Second (MIPS) rating.

Memory System:
Implementation of cache memory, internal memory, external memory.

Input/Output:
External devices, input/output module, input/output operation techniques.

Operating System:
Operating system overview, types of operating system, main functions of operating system.

Processor Structure and Function:
Processor and its register organization, instruction cycle and pipelining.

Parallel Architecture:
Multiple processors, cache memory uniformity and MESI protocol, vector computation, parallel processing.

Multimedia Implementation:
Fundamentals of digital imaging, audio and video. Multimedia interface.

Course Outcomes:
CO1: Be able to define, explain, and discuss terms regarding to computer systems architecture and organization.
CO2: Be able to explain and propose computer system design
CO3: Be able to explain, propose and design multimedia systems.

References:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 10th ed, Prentice-Hall, (2015)
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design:The Hardware and Software Interface", 5rd ed, Elsevier, (2014).
3. Yue-Ling Wong, "Digital Media Primer: Digital Audio, Video, Imaging and Multimedia Programming", 3rd ed, Pearson Prentice Hall, (2015).

EEE382/3 – Probability and Engineering Statistics

Objective: This course covers the concept of probability and engineering statistics. This course will provide students with a variety of engineering examples and applications based on the above topics.

Synopsis: This course reviews the topics on probability, discrete, continuous and bivariate probability distributions, confidence interval and hypothesis for mean and the difference between two population means, simple and multiple linear regressions, non linear regression and non parametric statistics.

Introduction to Probability
Sample space and events, Interpretation of probability, Addition rules, Conditional probability, Multiplication rule and total probability rules, Bayes theorem.

Analysis of Discrete Random Variables
Discrete random variables, Probability distributions and probbability mass functions, Cumulative distribution functions. Mean and variance of discrete random variable. Discrete uniform distribution, Bernoulli distribution, Binomial distribution and Poison distribution.

Analysis of Continuous Random Variables
Continuous random variables, Probability distributions and probability density functions, Cumulative distribution functions. Mean and variance of continuous random variable. Continuous uniform distribution, Normal distribution, Gammal distribution, chi square distribution, t distribution and F distribution.

Analysis of Joint Probability Distributions
Probability joint distribution for discrete random variables and continuous random variable.

Sampling Distributions
Confidence interval on the mean of a normal distribution, variance known. Confidence interval on the mean of a normal distribution, variance unknown. Confidence interval on the variance and standard deviation of a normal distribution. Ovariance, Correlation, Bivariate normal distribution.

Test of Hypotheses: Single Sample
Test on the mean of a normal distribution, variance known. Test on the mean of a normal distribution, variance unknown. Test on the variance and standard deviation of a normal distribution.

Test of Hypotheses: Two Samples
Inference on the difference in means of two normal distributions, variance known. Inference on the difference in means of two normal distributions, variance unknown. Inference on the variances of two normal distributions.

Analysis of Simple Linear Regression and Correlation
Simple linear regression. Properties of least square estimators. Hypothesis test in simple linear regression, Analysis of variance approach to test significance of regression. Confidence intervals. Adequacy of the regression model, Residual analysis, Coefficient of determination. Correlation.

Analysis of Multiple Linear Regression
Multiple linear regressions. Least squares estimation of the parameters. Properties of least square estimators. Hypothesis test in

multiple linear regressions, Test of significance of regression, Test on individual regression coefficients. Confidence intervals in multiple linear regressions. Adequacy the regression model, Residual analysis. Non linear regression.

Non Parametric Statistics

Sign test. Sign test for paired samples. Wilcoxon signed-rank test. Paired observation. Comparison to the test. Wilcoxon rank-sum test.

Non Parametric Methods in the Analysis of Variance

Kruskal Wallis test Rank transformation

Course Outcomes:

CO1: To be able to recognize techniques to solve problems in probability, probability distribution, joint probability distribution, sampling distribution, confident interval and hypothesis testing of single and two samples.

CO2: To be able to recognize techniques to solve problems in simple linear regression, multiple regression, hypothesis testing in multiple regression and non parametric statistics.

CO3: To be able to apply the above concepts for solving engineering problems, especially for sustainable production and consumption.

Reference:

1. William Navidi (2015). Statistics for Engineers and Scientists. 4th Edition McGraw Hill.
2. Geoffrey Vining, Scott M. Kowalski (2011). Statistical Methods for Engineers. 3rd Edition. Cengage Learning.
3. Douglas C. Mongomery, George C. Runger (2007). Applied Statistics and Probability for Engineers, 4th Edition. Wiley.
4. Anthony J. Hayter (2002).Probability and Statistics for Engineers and Scientists. 2nd Edition. Duxbury, Thomson Learning

EEE424/3 – Electronic Engineering Design

Objective: To emphasize and reinforce knowledge and skills in planning, management and implementation of integrated Electronic Engineering design, covering various technical aspects to take into account the safety, ethics, culture, community, well-being and environmental.

Synopsis: This course comprises solving complex electronic engineering problem by designing viable solutions that integrates components in core areas of Electronic Engineering and meeting specifiying needs with appropriate considerations for sustainability, public health and safety, societal, cultural and envionmental issues. The course will provides the knowledge about the management of a complex real case electronic engineering project which includes the project preparation, proposal, organization, management, innovation, funding and scheduling.

Course Outcomes:

CO1: Ability to identify the relevant solutions, methodologies, and theories used to solve Electronic Engineering design problems

CO2: Ability to select, apply, adapt, and innovate the relevant solutions, methodologies, and theories for designing Electronic Engineering systems by taking into account the safety and well-being of the environment and society

CO3: Ability to create effective teamwork in solving complex Electronic Engineering design problems involving technical, financial, ethical, management, environmental, and societal aspects.

References:

1. Nigel J. Smith (2007). Engineering Project Management, Wiley.
2. Paul Scherz (2013). Practical Electronic for Inventors, 3rd Edition, McGraw Hill Professional.
3. Fink and Beaty (2012). Standard Handbook for Electrical Engineers, 4th Edition, Mc Graw Hill.
4. Philippe Coussy and Adam Morawiec (2008). High-level Synthesis: From Algorithm to Digital Circuit, Springer.
5. Kim R. Fowler (2008). What Every Engineer Should Know About Developing Real-Time Embedded Products, CRC Press.
6. John Okyere Attia (2010). PSPICE and MATLAB for Electronics: An Integrated Approach, CRC Press.
7. Krzysztof Iniewski (2012). Embedded Systems: Hardware, Design, and Implementation, John Wiley & Sons.
8. Sammy G. Shina (2002). Six Sigma for Electronics Design and Manufacturing, McGraw Hill Professional.
9. Mark N. Horenstein (2010). Design Concepts for Engineers, Prentice Hall.

10. Peter Wilson and H. Alan Mantooth (2013). Model-Based Engineering for Complex Electronic Systems, Newnes.
11. Oliver L. de Weck, Daniel Roos, Christopher L. Magee and Charles M. Vest (2011). Engineering Systems: Meeting Human Needs In a Complex Technological World, The MIT Press.
12. B. S. Dhillon (2012). Safety and Human Error In Engineering Systems, CRC Press.
13. Obaidat, Anpalagan and Woungang (2012). Handbook of Green Information and Communication Systems, Academic Press.

EEE430/4 – Software Engineering

Objective: To expose the students the techniques of design, maintainance and testing of large scale software where emphasis will be based on object development.

Synopsis:

Introduction to Software Engineering

Scope of Software Engineering – the software crisis, principles of software engineering. Software Process – the software lifecycle, the waterfall model and variations, spiral model, risk driven approaches, evolutionary and prototyping approaches. Project Managements – project planning and estimation, risk analysis and management, cost model, version control, configuration managementTesting – testing process, strategies, and techniques. Maintenance – corrective maintenance, perfective maintenance, adaptive maintenance

Object-Oriented Concepts and Principles

The Concept of Objects. The Unified Modeling Language (UML). Object-oriented Analysis and Design – requirement and specification, analysis and design, implementation, integration

Mini Project

The application of the object-oriented principles

Course Outcomes:

CO1: Able to demonstrate an understanding of the principles and practices for software design and development

CO2: Able to apply the principles and practices for software design and development to real world problems involving individuals, organizations, and society

CO3: Able to analyze software development needs and challenges that requirevarious engineering solutions and formulate such solutions

CO4: Able to design software projects using existing engineering techniques and tools through team work and good implementation of communicating skills

References: 1. Sommerville I. (2010). Software Engineering, Addison Wesley, Boston.
2. S. Bennet, S. McRobb and R. Farmer (2002). Object Oriented Systems Analaysis and Design Using UML, McGraw Hill.
3. Stephen R. Schach (2002). Classical and Object-Oriented Software Engineering, 5th Edition McGraw Hill.

EEE 432/4 – Antennas and Propagations

Objective: To learn the characteristic of waveguides and analyzing and designing of antennas

Synopsis: This course reviews the topics on electromagnetic waves, waveguide, antenna design and analysis. It covers the sub topics of electromagnetic in homogeneous and no homogeneous media, rectangular and cylindrical waveguide, propagation mode, basic sources and types of antenna in reasonable propagation. Important concepts are introduced in the form of practical and necessary analytical techniques are applied to solve system.

Electromagnetic wave
EM wave in homogenous and in homogenous media, in dielectrics, in conductors , free space and guided wave

Waveguide
Parallel plates, rectangular waveguides, circular waveguides, modes in waveguide:TE , TM, TEM, evanesces mode and dominant mode.

Analysis and design of antenna
Isotropic antenna, dipole antenna, Hertzian dipole, straight wire antenna, half-wave dipole, monopole antenna, traveling wave antenna, directional and power gains, input impedances, radiation resistances, efficiency, impedance matching, balance unit, array antenna, Uda-Yagi antenna, aperture antenna.

Propagation
Free space, ground wave, sky wave, rain attenuation, scintillation, vegetation, ionospheric propagation, tropospheric propagation

Laboratories
Rectangular Waveguide, Dipole antenna, Yagi antenna, Hon antenna, Ground wave propagation and EMC.

Course Outcomes:
CO1: Analyzing the waves in condition of homogeneous and non-homogeneous.
CO2: Able to determine the modes and frequency ranges for waveguides.

CO3: Understand the mechanism of radiation with reference to the source, radiation characteristics and able to apply them for the design and analysis of antenna.

CO4: Understand and apply the characteristics of waves propagation and EMC in solving engineering problems.

References:

1. Syed Idris Syed Hassan, "Antenna dan Perambatan", First ed. USM (1997)
2. C. A. Balanis, "Antenna Theory, Analysis and Design", Wiley, 4t. Edition (2016)
3. Antenna Theory and Design, 3rd. Edition, Warren L. Stutzman, Gary A. Thiele, (2016), Publisher: Material
4. Magdy F. Iskander, "Electromagnetic Fields and Waves", Prentice Hall Int. Edition, (2001)
5. J. D Kraus, "Antenna", McGrawHill (2001)
6. Jordan E.C. and Balmain.K.G, "Electromagnetic Waves and Radiating Systems", Prentice-Hall (1980)

EEE 440/4 - Modern Communication System

Objective: To give an opportunity to the students to learn up-to-date technology and various electronic communication systems.

Synopsis: This course reviews the topics on optical fiber, cellular and satellite communication systems. It covers the topics of system components, channels, operations and performance. Important concepts are introduced and necessary analytical techniques are applied to solve system problems.

Part 1- Optical Fiber Communication

Introduction to Optical Fiber Communication:

Student will be exposed to the historical development of optical fiber and Basic system for optical communication. Also the need of optical communication compared to the usage of copper wire.

Optical Communication Channel

This topic will cover the attenuation in optical fiber which limit the distance of an optical channel transmission line. Types of optical fiber will be explained such as single mode and multi-mode.

Optical Source for Optical communication.

This section will expose the student to the structure and operational method of optical sources and also types of optical sources that commonly used such as LASER and LED.

Optical detection and Receiver
Student will be introduced to the optical receiver and detection that available in the market. Apart from this, the effect of noise on receiver and detection will also be clarified.

Part 2- Cellular Telephone System
Introduction to Cellular Telephone System
Students are exposed to the concept and evolution of cellular telephone system.

Cellular Telephone Concept
This section will describe the application of frequency reuse, interference, cell division, sector , segment and binary. Apart from that , the students will be exposed to the topology of cellular system and rooming.

Cellular Telephone System
Student will be explained the first generation the analogue cellular telephone system, PCS, GSM and 3G.

Part 3- Satellite Communication
Introduction to Satellite Communication System
Historical of satellite communication system , Kepler law, satellite orbits, GEO and LEO satellite will be explained.

Satellite Antenna
Types of antenna, radiation pattern of satellite antenna.

Link budget
Satellite link model, satellite system parameters, link equation

Multiple accesses
FDM/FM satellite system, multiple accesses, channel capacity.

Course Outcomes:
CO1: Able to design solutions for the problems related to communication components, as well as discuss the characteristics / processes in fiber optics, cellular and satellite communications.
CO2: Able to provide judgment to the solutions related to the communication components, as well as analyze the characteristics processes in fiber optics, cellular and satellite communications.

References:
1. Govind P. Agrawal, "Fiber Optic Communication Systems", 4th Ed., Wiley, (2010).
2. Schwartz, M., "Mobile Wireless Communications", Cambridge University Press, (2013).

3. Prof. Andrea Goldsmiths, “Wireless Communications Lecture Notes” from Stanford University, (2014).
4. Simon Haykin, Micheal Moher, “Modern Wireless Communication”, Pearson Prentice Hall, (2005).
5. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, 2nd Ed., Prentice Hall, 2002.
6. Andreas F. Molisch., ”Wireless Communications”, 2nd Ed.., Wiley, 2010.

EEE443/3 – Digital Signal Processing

Objective: To learn the analysis and methods for the design of digital filters.

Synopsis: This course introduces the topics on discrete-time signal and system ranging from the basic theory until the design of FIR and IIR digital filters. The topics covered are signals, systems, discrete-time system, Z transform, discrete Fourier transform (DFT), Fast Fourier Transform (FFT), structure of discrete-time systems and design of FIR and IIR digital filters.

Review of Signal and Discrete-Z Time System
Z- transform and its applications and analysis of the linear invariant time system. Discrete time frequency analysis and Fourier transform of discrete signals and their bahaviours. Frequency domain characteristics of inear time invaraiant system and its applications.

Discrete Fourier Transform
Frequency domain sampling, discrete Fourier transform as linear transform.

Behaviours of discrete Fourier transform. Circularly symmetry. Methods for Linear filtering using discrete Fourier transform. Signal analysis in frequency domain using discrete Fourier transform.

Fast Fourier Transform (FFT)
Split and rule method. Radix-2 FFT algorithm, Radix-4 FFT algorithm, Quantization effect on the computation of discrete Fourier transform.

Structure of FIR system
Direct shape I and II, cascade, parallel shape and lattice structure, state space structure, representation of numbers, quantization of coefficient filters, round-off effects in digital filters.

Design of FIR filters
Causality and its applications, Symmetrical and non-symmetrical FIR filters, linear phase filters using windows, linear phase filters using frequencys ampling

Design of IIR filters

Design of IIR filters based on derivative approximation, invariant impulse and linear transform. General characteristics of analog filters and frequency transform.

Course Outcomes:

CO1: To be able to conduct investigations, such as decompose discrete time signals into components, in order to understand the fundamentals of discrete-time signal

CO2: To be able to use the fundamental transformations to analyze and interpret the discrete-time signal

CO3: To properly design FIR and IIR digital filters, and comprehend the usage of these filters towards the sustainability of the society.

CO4. To be able to implement and design the environmental friendly discrete-time system structure, which requires less resources

References:

1. Alan V. Oppenheim, Ronald W. Schafer with John R. Buck, "Discrete-Time Signal Processing", Prentice-Hall Signal Processing Series, 3rd Ed., (2014).
2. John, G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing-Principles, Algorithms, and Applications", Prentice-Hall International, Inc., 4th Edition, (2007).
3. Sanjit K. Mitra, "Digital Signal Processing – A Computer-Based Approach", McGraw-Hill, 4th Ed., (2010).

EEE445/4 – Analogue Integrated Circuit Design

Objective: To learn methodologies of designing Analogue IC.

Synopsis: This course covers the theory, analysis and realization of the analog integrated circuits focusing on CMOS technology. The analysis of the single stage amplifiers, multiple stage and differential amplifiers with the practical laboratory covering the realization and validation through pre-layout and post-layout simulations. Finally, the designed circuits will be prepared in the form of standard layout (eg gds format).

Course Outcomes:

CO1: To be able to design passive/active current mirror.

CO2: To be able to design CMOS amplifier

CO3: To be able to develop/derive the noise parameters in integrated circuit/feedback amplifier.

References:

1. Razavi, B., (2016). Design of Analog CMOS Integrated Circuits, ISBN:10: 0072524936 Mc Graw Hill
2. Arjuna Marzuki (2015). CMOS Operational Amplifier. Lecture Note.

EEE449/3 – Computer Networks

Objective: To provide the students to understand the concepts of protocols, network topologies, and examples application protocol such as e-mail, and open system protocols such as MAP.

Synopsis: This course offers students to learn the concepts of data communications, data-link layer protocols, MAC layer protocols and network topologies.

Introduction:
Introduction to data communications and computer networks, Types of communication networks, Network topologies, Internet history, Network models, Protocol layering, TCP/IP protocol suite, OSI model

Physical layer:
Analog and digital data transmission techniques, Transmission media, Transmission impairments, Channel capacity, Line coding schemes, Bandwidth utilization, Multiplexing and demultiplexing, Circuit and packet switching

Data-link layer:
Types of data links, Data-link layer services, Framing, Error detection and correction techniques, Data-link control (DLC) protocols (Simple, Stop-and-Wait), Medium access control (MAC) protocols (FDMA, TDMA, CDMA, Polling, Token passing, ALOHA, Slotted ALOHA, CSMA, CSMA/CD)

Network layer:
Network layer services, Network layer protocols, Internet protocol (IP), Datagram fragmentation, Addressing in IPv4, Classful and Classless addressing, Subnetting, Routing algorithms (Dijkstra algorithm, Bellman-Ford algorithm)

Transport layer:
Transport layer services, Process-to-process communication, Flow and error control, Automatic repeat request (ARQ) protocols (Stop-and-Wait, Go-Back-N, Selective-Repeat), Connectionless and connection-oriented services, Transmission control protocol (TCP), User datagram protocol (UDP)

Application layer:
Application layer protocols, Domain name system (DNS) (DNS name space, DNS servers, DNS caching), World Wide Web (WWW), HyperText transfer protocol (HTTP), Web caching.

Course Outcomes:
CO1: Able to design solutions for complex engineering problems in computer network systems.
CO2: Able to use the appropriate techniques, resources, and modern engineering tools for application in computer networks.

References:

1. B. A. Forouzan. Data Communications and Networking. 5th Edition, McGraw-Hill, (2013)
2. Stallings W., Data and Computer Communications, 10th ed., Prentice Hall, (2013).
3. J. F. Kurose and K. W. Ross. Computer Networking: A Top-Down Approach, 6th Edition, Pearson, (2012).

EEE453/4 - Control Systems Design

Objective: To study the analysis and design techniques for control systems using state space approach, system identification and optimal control.

Synopsis: This course covers the basic concepts of control systems, state-space variables, and state-space modeling of dynamical systems. It also covers design and analysis of control systems using state-space method, system identification, optimal control, and advanced control techniques.

Review of Basic Control Systems
Laplace and Z transforms, transfer functions and system stability. Time and frequency response, root locus, Bode diagram and Nyquist plots.

State-space Variable and State-space Modelling of Dynamical Systems
State-space concept, state equation and state space representation. System modes, modal decomposition and transition matrices. Controllability and observability. Stability and stabilisability.

Control System Design using State-space Method
Pole placement and Ackermann's formula. Estimator design: prediction, current and reduced order. Controller design: separation principle, full state feedback, state control and integral control.

System Identification
Identification process, type of input signals, type of models, nonparametric identification, parametric identification, parameter estimation: Least Squares (LS), recursive LS, stochastic LS algorithm and maximum likelihood – numerical sequence, application examples.

Introduction to Optimal Control
Optimization principle, Pontryagin's minimum principle, steady state optimal control with LQR.

Introduction to Advance Control Techniques
Adaptive, fuzzy and neural network control systems.

Laboratory
Simulation of state equation representation, design of state feedback controller, design of state estimator, system identification LS, IV and RLS, design of optimal controller LQR.

Application of MATLAB and SIMULINK

Course Outcomes:

CO1: To be able to describe techniques employed in modelling and control of a dynamical system

CO2: Able to apply appropriate methods and analyse problem in control system.

CO3: To be able to design control system and evaluate the performance of the designed control system

References:

1. Robert L., II Williams, Douglas A. Lawrence, Linear State-Space Control Systems, Wiley, (2007).
2. CT Chen, Linear System Theory and Design, Oxford University Press, (2012).
3. John C. Doyle, Bruce A. Francis, Allen R. Tannenbaum, Feedback Control Theory, Dover, (2009).
4. Rolf Isermann, Marco Münchhof, Identification of Dynamic Systems: An Introduction with Applications, Springer, (2010).

EEE499/6- Undergraduate Project

Objective: A small scale research project will be undertaken by every final year student. The aim of the project is to train the student indentify some problems related to electronic engineering and introducing them with the techniques of investigation, solving problems , writing a technical report and presentation of the results in the form of thesis and seminar.

Course Outcomes:

CO1: To be able to design, implement, analyse and synthesize a solution for a given engineering problem using the inherent tools of engineering.

CO2: To be able to plan, organize, build and utilize systems approach in an engineering project and able to apply in depth knowledge of a technical topic and practical aspects of engineering.

CO3: To be able to express, justify and defend their ideas and information in written and oral form according to professional and ethical practices.

CO4: To be able to apply their personal capabilities in accomplishing the goal throughout the whole process.

STRUKTUR IJAZAH SARJANA MUDA KEJURUTERAAN (KEPUJIAN) KEJURUTERAAN ELEKTRIK
BACHELOR ENGINEERING (HONS) (ELECTRICAL ENGINEERING) STRUCTURE

6.0

	100		2		300		4	
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**	**Semester 7**	**Semester 8**	
TERAS *(CORE)*	**EUM 111/3** **Kalkulus Kej.** *(Engineering Calculus)*	**EUM114/3** **Kalkulus Kejuruteraan Lanjut** *(Advanced Engineering Calculus)*	**EEE232/3** **Analisis Kompleks** *(Complex Analysis)*	**EEE276/3** **Teori Elektromagnet** *(Electromagnetic Thory)*	**EEK 361/3** **Elektronik Kuasa** *(Power Electronics)*	**EEK360/3** **Makmal Elektrik** *(Electrical Laboratory)*	**EEK 468/3** **Pacuan & Mesin Elektrik** *(Electrical Machine & Drives)*	**EEK499/6** **Projek Prasiswazah** *(Undergraduate Project)*	
	EBB113/3 **Bahan Kej.** *(Engineering Material)*	**EEE125/3** **Makmal Asas Litar** *(Basic Circuit Lab)*	**EEE231/3** **Makmal Elektronik Digit** *(Digital Electronics Lab)*	**EEE243/3** **Makmal Elektronik Analog** *(Analog Electronics Lab)*	**EEK 369/3** **Kejuruteraan Voltan Tinggi** *(High Voltage Engineering)*	**EEK372/3** **Analisis Sistem Kuasa** *(Power System Analysis)*	**EEK425/3** **Reka Bentuk Kejuruteraan Elektrik** *(Electrial Engineering Design)*	**EEK470/4** **Sistem Pengagihan Elektrik Kuasa** *(Electric Power Distribution System)*	
	EMM101/3 **Mekanik Kej.** *(Engineering Mechanical)*	**EEE130/3** **Elektronik Digit I** *(Digital Electronic I)*	**EEE208/3** **Teori Litar II** *(Circuit Theory II)*	**EEE226/3** **Mikropemproses I** *(Microprocessor I)*	**EEE332/4** **Perhubungan** *(Communication)*	**EUP 222/3** **Jurutera Dalam Masyarakat** *(Engineer In Society)*			
	EEE105/3 **Teori Litar I** *(Circuit Theory I)*	**EEE133/3** **Peranti Elektronik** *(Electronic Devices)*	**EEE241/3** **Elektronik Analog I** *(Analog Electronics I)*	**EEK260/3** **Mesin Elektrik** *(Electrical Machines)*	**EEE350/3** **Sistem Kawalan** *(Control Systems)*	**EEM323/3** **Sistem Peralatan dan Pengukuran** *(Instrumentation & Measurement Systems)*			
	EEE 123/3 **Pengaturcaraan Komputar Utk Jurutera** *(Computer Programming for Engineers*	**EEL102/2** **Amalan Kejuruteraan** *(Engineering Practice)*	**EEE228/3** **Isyarat & Sistem** *(Signal And System)*	**EEK241/3** **Teknologi Elektrik Kuasa** *(Electrical Power Technology)*	**EEE382/3** **Kebarangkalian & Statistik Kej.** *(Probability & Engineering Statistic)*				
	15	**14**	**15**	**15**	**16**	**12**	**6**	**10**	**108**
KEP.UNIV. (UNI. REQ.)	**LKM 400/2 B.Malaysia** *(Malay Language)*	**WUS101/2** **Teras Keusahawanan** *(Core Entrepreneurship)*	**LSP/2** **B.Inggeris** *(English Language)*	**HTU 223/2** **TITAS** *(Islamic and Asian Civilisations)* **SHE101/2** **Hubungan Etnik** *(Ethnic Relations)*	**LSP/2** **B.Inggeris** *(English Language)*			OPSYEN/3 *(Option/3)*	**15**
ELEKTIF *(ELECTIVE)*	Pelajar perlu mengambil tiga kursus elektif seperti berikut: i) Opsyen A : Semua tiga kursus elektif dari program elektrik ii) Opsyen B: Dua kursus elektif dari program elektrik dan satu kursus elektif dari program elektronik atau mekatronik Student should take elective courses as follow: i) Option A: All three elective courses are from electrical program ii) Option B: Two elective courses are from electrical program and one elective course is from electronic or mechatronic Prog.					**EEK373/4** **Elektronik Kuasa Lanjutan** *(Advanced Power Electronic)* **EEM348/4** **Prinsip Sistem Pintar** *(Principle of intelligent System)* **EEE322/4** **Kej. Gelombang Mikro & RF** *(RF & Microwave Engineering)*	**EEK 474/4** **Rekabentuk Mesin Elektrik** *(Electrical Machine Design)* **EEK 475/4** **Ekonomi & Pengurusan Sistem Kuasa** *(Economy And Management Of Power System)* **EEK 477/4** **Tenaga Diperbaharui** (Renewable Energy)		**12**
	17	16	17	19	18	16	14	13 10 (Tanpa Opsyen)	**135**
	JUMLAH UNIT MINIMUM BAGI PENGIJAZAHAN *(TOTAL MINIMUM UNIT FOR GRADUATION)*								**135**

Cuti Pertengahan Semester *(Mid Semester Break)*

Cuti Panjang *(Long Vacation)*

Cuti Pertengahan Semester *(Mid Semester Break)*

Cuti Panjang *(Long Vacation)*

Cuti Pertengahan Semester *(Mid Semester Break)*

EEL303/5 Latihan Industri *(Industrial Training)*

Cuti Pertengahan Semester *(Mid Semester Break)*

BACHELOR OF ENGINEERING (HONOURS) (ELECTRICAL ENGINEERING)
6.1 CURRICULUM

LEVEL 100

		Credit	Contact Hours	
		Total Unit	Lecture	Lab/ Tutorial
Semester I				
EEE105/3	Circuit Theory 1	3	3	1
EEE123/3	Computer Programming for Engineers	3	2	2
EBB113/3	Engineering Materials	3	3	1
EMM101/3	Engineering Mechanics	3	3	1
EUM113/3	Engineering Calculus	3	3	1
		15	**14**	**6**
SEMESTER BREAK				
Semester II				
EEE125/3	Basic Circuit Laboratory	3	0	6
EEE130/3	Digital Electronics 1	3	3	1
EEE133/3	Electronic Devices and Circuit	3	3	1
EEL102/2	Engineering Practices	2	0	4
EUM114/3	Advanced Engineering Calculus	3	3	1
		14	**9**	**13**
LONG VACATION				

LEVEL 200

		Credit	Contact Hours	
		Total Unit	Lecture	Lab/ Tutorial
Semester I				
EEE208/3	Circuit Theory II	3	3	1
EEE228/3	Signals and Systems	3	3	1
EEE231/3	Digital Electronics Laboratory	3	0	6
EEE232/3	Complex Analysis	3	3	1
EEE241/3	Analogue Electronics I	3	3	1
		15	**12**	**10**
SEMESTER BREAK				
Semester II				
EEK241/3	Electrical Power Technology	3	3	1
EEK260/3	Electrical Machines	3	3	1
EEE226/3	Microprocessors I	3	2	2
EEE243/3	Analog. Electronics Laboratory	3	0	6
EEE276/3	Electromagnetic Theory	3	3	1
		15	**11**	**11**
LONG VACATION				

LEVEL 300

		Credit	Contact Hours	
		Total Unit	**Lecture**	**Lab/ Tutorial**
Semester I				
EEK361/3	Power Electronics	3	3	1
EEK369/3	High Voltage Engineering	3	3	1
EEE332/4	Communication	4	4	1
EEE350/3	Control Systems	3	3	1
EEE382/3	Probability & Engineering Statistic	3	3	1
		16	**16**	**5**
SEMESTER BREAK				
Semester II				
EEK360/3	Electrical Laboratory	3	0	6
EEK372/3	Power System Analysis	3	3	1
EEM323/3	Instrumentation And Measurement Systems	3	3	2
EUP222/3	Engineers in Society	3	3	0
		12	**9**	**9**
EEL303/5	Industrial Training (10 WEEKS)	**5**	**0**	**12**
Elective				
EEE322/4	Microwave & RF Engineering	4	2	4
EEM348/4	Principle of Intelligent Systems	4	3	2
EEK373/4	Advanced Power Electronic	3	3	1
LONG VACATION				

LEVEL 400

		Credit	Contact Hours	
		Total Unit	**Lecture**	**Lab/ Tutorial**
Semester I				
EEK468/3	Electrical Machine and Drives	3	2	2
EEK425/3	Electrical Engineering Design	3	1	6
		6	**3**	**8**
Elective				
EEK477/4	Renewable Energy	4	3	2
EEK474/4	Electrical Machine Design	4	3	2
EEK475/4	Economy & Management of Power System	4	3	2
SEMESTER BREAK				
Semester II				
EEK499/6	Undergraduate Project	6	0	12
EEK470/4	Electric Power Distribution System	4	3	2
		10	4	12
LONG VACATION				

6.2 COURSE- PROGRAMME OUTCOMES MATRIX

				EMPHASIS TO THE PROGRAM OUTCOMES											
				PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
COURSE CODE		**SEM**	**DESCRIPTION**												
Level 100															
1	EUM 113/3	1	Engineering Calculus	X	X										
2	EBB113/3	1	Engineering Material	X											
3	EMM101/3	1	Engineering Mechanical	X	X		X								
4	EEE105/3	1	Circuit Theory I	X	X										
5	EEE123/3	1	Computer Programming for Engineers		X	X									X
6	LKM400/2	1	Malay Language									X			
7	EUM114/3	2	Advanced Engineering Calculus	X	X										
8	EEE125/3	2	Basic Circuit Lab			X						X	X	X	
9	EEE130/3	2	Digital Electronic I		X				X						
10	EEE133/3	2	Electronic Devices & Circuit	X						X					
11	EEL102/2	2	Engineering Practice			X		X				X	X		
12	WUS101/2	2	Core Entrepreneurship									X	X		X
13	SHE101/2	2	Ethnic Relations								X	X			
Level 200															
14	EEE232/3	3	Complex Analysis		X		X								
15	EEE231/3	3	Digital Electronics Laboratory					X			X	X		X	
16	EEE208/3	3	Circuit Theory II				X			X					
17	EEE241/3	3	Analog Electronics I	X					X						
18	EEE228/3	3	Signal and System	X	X										
19	LSP/2	3	English Language									X			
20	EEE276/3	4	Theory of Electromagnetic		X				X						
21	EEE226/3	4	Microprocessor I			X					X	X			X
22	EEK 241/3	4	Electrical Power Technology	X	X	X				X					
23	EEK 260/3	4	Electrical Machines	X	X	X									
24	EEE243/3	4	Analog Electronic Laboratory			X		X					X	X	
25	HTU223/2	4	TITAS								X				

Level 300

26	EEK 361/3	5	Power Electronic	X	X	X		X							
27	EEK 369/3	5	High Voltage Engineering		X			X		X					
28	EEE332/4	5	Communication			X					X				
29	EEE350/3	5	Control Systems				X	X							
30	EEE382/3	5	Probability & Eng. Statistic			X			X						
31	LSP/2	5	English Language									X			
32	EEK360/3	6	Electrical Laboratory				X				X	X	X	X	
33	EEK372/3	6	Power System Analysis		X	X		X							X
34	EUP222/3	6	Engineer in Society	X			X		X		X	X		X	
35	EEM323/3	6	Instrumentation & Measurement Systems	X	X	X		X				X			
36	EEK 373/4	6	Advanced Power Electronic		X	X		X					X		
37	EEM348/4	6	Principle of Intelligent System	X	X			X					X		
38	EEE322/4	6	RF & Microwave Engineering				X			X					
39	EEL 303/5	6	Industrial Training						X			X		X	X

Level 400

40	EEK468/3	7	Electrical Machine & Drives		X	X		X							
41	EEK475/4	7	Economy and Management of Power System		X				X	X				X	
42	EEK477/3	7	Renewable Energy	X				X		X					
43	EEK425/3	7	Electrical Engineering Design			X			X	X		X	X	X	X
44	EEK474/4	7	Electrical Machine Design		X	X		X				X	X		
45	EEK 499/6	8	Undergraduate Project				X		X				X	X	X
46	EEM421/4	8	Electrical Power Distribution System			X				X			X		X
47	EEK470/4	2	Electric Power Distribution System			X	X		X	X	X				

Legend

PO1- Engineering Knowledge
Ability to apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.

PO2- Problem Analysis
Ability to identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3- Design/Development of Solutions
Ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO4- Investigation
Ability to conduct investigation of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, synthesis of information to provide valid conclusion.

PO5-Modern Tool Usage
Ability to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.

PO6- The Engineer and Society
Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.

PO7- Environment and Sustainability
Ability to understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.

PO8 – Ethics
Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9- Individual and TeamWork
Ability to function effectively as an individual, and as a member or leader in teams and in multi-disciplinary settings.

PO10- Communication
Ability to communicate effectively on complex engineering activities with the 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.

PO11- Project Management and Finance
Ability to demonstrate knowledge and understanding of engineering and management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12- Life Long Learning
Ability to 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.

6.3 COURSE DESCRIPTION

EEK241/3 - Electrical Power Technology

Objective: To understand the basic principles of electrical power technology, electric power generating, transmission and distribution, power Instrumentation and electric power application and safety system.

Synopsis: This course is offered for students to learn and understand basic principles of electrical power technology such as single-phase and three-phase ac network, electric power generation, power transmission and distribution, power measurements and instrumentation, protection systems, and renewable and alternatives energy sources.

Electrical network
AC and DC network, Current and voltage characteristics, The average, effective or rms values. Phasor and graphics. The real, reactive and complex power. Phase angle and power factor correction. Single and three-phase systems. Per-Phase Analysis and single line diagram.

Electric Power Generating
The principle operation of generator, types of electric power plants, alternative power plants, synchronous Generator and basic components and functioning. Real and reactive power of generator. Single line model of AC generator. Loading of generator.

Electric Utility Power System
Transmission of electrical energy, principal components of power transmission system, type of power transmission, standard voltage, component of transmission line, fundamental objectives of a transmission line, equivalent circuit of lines. Direct-current transmission, Substation of power distribution system, substation equipment, type of power distribution system, circuit breaker, disconnecting switches, grounding, arrester, voltage regulation and low voltage distribution.

Loads
Type of loads on power system, resistive loads, inductive loads and motors, electronics equipment loads. Load profiles and loads duration curve. Simple Load flow calculation, power factor and power factor correction.

Power Instrumentation
Type of electrical instrumentation, moving coil, hot wire, thermocouple, electrodynamics, pointer, AD and DC instrumentation, Ammeter, Voltmeter, Wattmeter, VAR meter, frequency meter. Classification and

standard of Instrumentation, Measurement methods for current, voltage, power and power factor in single phase and three-phase. Magnetic measurement, Digital instrumentation.

Laboratory

Experiments will be conducted encompassing basic electric system (Generator, transformer, transmission, loads, real power, reactive power, complex power, electrical measurement and instrumentation).

Course Outcomes:

CO1: Able to define the basic characteristics and the laws of electric and magnetic and their applications in electrical networks

CO2: Able to explain and analyze the complex power and power factor for single phase and three phase circuits

CO3: Able to explain and evaluate the technology used in electrical power generation, transmission and distribution

References:

1. Theodore Wildi, "Electric Machines, Drives and Power Systems", 6th Edition, Pearson, (2014).
2. S. Tumanski, "Principles of Electrical Measurements", Taylor & Francis, (2006).
3. Alexandra Von Meier, "Electrical Power System A Conceptual Introduction"**,** John Willey & Son, (2006).
4. M. Weedy and B.J. Cory, "Electric Power System", 4th Edition, John Willey & Son, (2001)

EEK260/3 – Electrical Machines

Objective: To learn the theory, construction, operation and fundamental characteristics of transformers, DC electrical machines, AC electrical machines, and special electrical machines.

Synopsis: This course covers the topics of magnetic circuit fundamental, transformer, dc generator, dc motor, three-phase synchronous motor, three-phase synchronous generator, three-phase and single-phase induction motors.

Magnetic Circuits

Magnetic field in conducting coils, important magnetic parameters Φ, i-H and B-H, F relation, magnetic equivalent circuit and magnetizing curve, effect of hysteresis, eddy current and core loss, permanent magnet and electromagnetic conversion.

Transformers

Structures and principle of transformer operation, single -phase transformer, ideal transfor mer, equivalent circuit and impedance transfer, determination

of equivalent circuit parameters and vector diagram, efficiency, single and three-phase transformers, voltage regulation, auto -transformers, instrument
transformers (CT and VT) and parallel of transformers.

DC Electric Machines

Constructions of DC electrical machines, armature winding, armature reaction, voltage generating and developed torque. Classification and types of DC machines, DC generators and motors (Separately, shunt, series and compound generators) and their operation characteristics.

AC Electrical Machines

Single-Phase AC electrical machine. Constructions, operating principle and equivalent circuit of AC electrical machine. Single phase AC motors, starting capacitor and running capacitor characteristics, reluctance and hysteresis motors, speed and torque, power loss and efficiency calculation. Single phase generator, loading characteristic and voltage regulation.

Three-phase Induction Machines. Three-phase induction machines, construction features, rotating magnetic field and induced voltage, equivalent circuit, determination of equivalent circuit and parameters (open - circuit and lock rotor test), performance characteristics of developed voltage, speed, slip and torque, mode of operation (motoring, generating and plugging), wound rotor and squirrel cage rotor, effect resistance of rotors. Starting of induction motors.

Three-phase Synchronous Machines (Alternators). Construction of three-phase synchronous machines, equivalent circuit model, determination of synchronous reactance Xs. Operation as generator and motor. Salient pole synchronous machine. Loading operation, power factor and capability curve and parallel operation.

Course Outcomes:

CO1: Able to define, describe and relate the types, characteristics and operating principles of transformers, dc machines and ac machines

CO2: Able to calculate the magnetic fields, flux, torque, speed, power and efficiency of electrical machines

CO3: Able to analyse and solve problems related to transformers, dc machines and ac machines

References:

1. Stephen Chapman, "Electric Machinery Fundamentals", McGraw-Hill, 4th Edition, (2003)
2. DP Kothari and IJ Nagrath, "Electric Machines", Tata McGraw-Hill, 3rd Edition, (2004).
3. A.E. Fitzgerald, C. Kingsley, and S.D. Umans, "Electric Machinery", Mc Graw-Hills, 6th Edition, (2003)

4. Mulukutla S. Sarma and Mukesh K. Pathak, "Electric Machines", Cengage Learning, 2010.
5. Theodore Wildi, "Electric Machines, Drives and Power Systems", 6th Edition, Prentice Hall, 2006.
6. SK Bhattacharya, "Electrical Machines", Tata McGraw-Hill, 3rd Edition, 2009

EEK360/3 - Electrical Laboratory

Objective: The course introduces laboratory experiments and exercises to the students in order to enhance the students' understanding and knowledge on the construction, operating, standards and basic characteristics of AC and DC electrical machines (motor and generator). Understanding of operate the power generating system, distribution, loading system and their protections.

Synopsis: This course will let the students to conduct experiments in Electrical Laboratory about the use and measurement of the electrical power system, power generation, electric power transmission and distribution, protection system and voltage regulation. Known and understands of electrical equipments construction, characteristics, efficiency and able to operate of the electric machines such as single-phase and three-phase transformers, three phase synchronous generator and motor, single and three-phase alternating current (AC) induction motors, direct current (DC) motor and generator, separately DC, series, shunt and compound.

Course Outcomes:
CO1: Able to describe the basic standard and rating of electrical machines and power system.
CO2: Able to describe the operation of electrical machines and power systems and use appropriate measurement tools to analyze their performance and characteristics
CO3: Able to evaluate and write reports on the performance of electrical machines and power system operations by working as a group or as an individual

References:
1. Theodore Wildi, " Electric Machines, Drives and Power Systems", 6th Edition, Prentice Hall, 2014.
2. Stephen Chapman, "Electric Machinery Fundamentals", McGraw-Hill, 4th Edition, 2013
3. Rashid, M H., "Power Electronics: Circuit, Devices & Applications", Prentice Hall, 3rd Edition, 2012.
4. Hadi Saadat, Power System Analisis", McGraw-Hill, 2014

EEK361/3: Power Electronics

Objective: This course is offered in order to provide sound knowledge and understanding on power electronic devices, their characteristics, triggering and control circuits, switching operation, switching loss, efficiency and their use for industry applications.

Synopsis: This course is offered to provide sound knowledge on the power electronics circuits and devices. The course explains in details the ideal and practical characteristics of the power diode, thyristor and transistors. Power electronics circuits such as controlled and uncontrolled rectifier, dc-dc converter and ac voltage controller will be covered. Practical design consideration for power electronics circuits such as current and voltage protection and thermal protection will also be explained.

Introduction to Power Electronics
Type of power electronic controls, efficiency of power electronic circuits, switching devices rating, switching semiconductor applications, analysis method, applications of power electronic circuits.

Power Diode
PN diode, static model, diode recovery operation, Schottky diodes, dynamic performance, diode applications, power diode connections.

Thyristor
Thyristor characteristics, thyristor turn-on, thyristor turn-off, thyristor types, TRIAC, GTO, LASCR, thyristor series and paraller connections, thyristor firing circuit.

Power Transistor
BJT, on state model and cut off model, safe operating area, MOSFET modelling and capacitances, MOSFET switching losses, MOSFET turn on and turn off, MOSFET switching losses, MOSFET source inductance, IGBT, FCT, MOS-Controlled, transistor.

Design Considerations
Semiconductor junction temperature, single pulse operation, periodic pulses operation, over current protection, over voltage protection, external transients, snubber circuits, thermal protection.

Power Electronics Circuits
Uncontrolled rectifier, controlled rectifier, single and three phase ac to ac control, dc to dc converter (Buck, Boost and Buck-Boost).

Course Outcomes:
CO1: Able to define different types of semiconductor components and their applications in the power electronics circuits.
CO2: Able to analyse the characteristics of the semiconductor components and the protection required by the devices and the converter circuits.
CO3: Able to evaluate the performance of the semiconductor components and the basic converter circuits.

References:

1. M H Rashid, "Power Electronics: Circuit, Devices & Application", 4th Edition, Pearson, (2014)
2. W. H. Daniel, "Power Electronics", McGraw Hill, (2011)
3. M.S. J Asghar, "Power Electronics", Prentice Hall India, (2004)
4. N. Modan, T.M. Underland & W. Robbins, "Power Electronics: Converter, Applications and Design", Wiley, 2003

EEK369/3 – High Voltage Engineering

Objective: To provide an understanding of the basics theories and concepts of High Voltage Engineering and it application.

Synopsis: This course covers the topics of introduction of high voltage system, electrical breakdown theory, overvoltage phenomena and insulation coordination, protection system, circuit breakers, high voltage generation and measurement.

Introduction
High voltage power system, classification of voltage, HV/ Electric field stresses, gas, liquid and solid as an insulator.

Electrical Breakdown Theory
Influence of electric fields on power system equipment design; environmental effects of overhead HV lines; voltage distribution and breakdown voltage of insulators; pollution and aging effect on insulators.

Overvoltage and insulation coordination
Types of overvoltage, lightning phenomena, lightning effect on power systems, lightning and surge protection, switching overvoltage, grounding principle and insulation coordination.

Protection System
Apparatus of protection, auto-reclosing (single and 3-phase), testing and maintenance of switchgear.

Circuit Breakers
Theory of circuit interruption; circuit constants relating to circuit breakers; theory and practice of conventional circuit breakers; advances in circuit breakers; testing of circuit breakers.

Laboratory
Laboratory work on electrical field distribution simulation and breakdown voltage.

High voltage generation and measurement.
Half-wave and full-wave rectifier, voltage ripple, principle of voltage multiplier circuit, high voltage measurement technique, type of high voltage divider and determination method, partial discharge measurement technique

Course Outcomes:

CO1: Able to define and explain the dielectric characteristics and physical properties of the insulation materials typically used in high voltage system

CO2: To be able to explain, interpret and examine the overvoltage phenomenon, protection system principles and insulation coordination

CO3: To be able to explain, construct and evaluate the principal of circuit breaker, high voltage generation and high voltage measurement.

References:

1. Naidu and Kamaraju, “High Voltage Engineering”, 5th edition, Tata McGraw-Hill, New Delhi, (2013). ISBN: 978-1-25-906289-6
2. Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy and Roshdy Radwan, “High Voltage Engineering, Theory and Practice”, Marcel Dekker, New York, (2000). ISBN: 0-8247-0402-9
3. E. Kuffel, W.S. Zaengl and J. Kuffel, “High Voltage Engineering: Fundamentals”, 2nd ed. Newnes (2000).
4. Haddad and D. Warne, “ Advances in High Voltage Engineering”, IEE Power and Energy Series 40, (2004).
5. Hugh M. Ryan, “High Voltage Engineering and Testing”, 2nd ed. The Institute of Electrical Engineers, Power and Energy Series 32, (2001).
6. Yoshihide Hase, “Handbook of Power System Engineering”, John Wiley & Sons Ltd., (2007).
7. Gallagher and Pearmain, "High Voltage: Measurement, Testing and Design", John Wiley & Sons, New York, (1983).
8. Ravindranath B., & Chander, M., Power System Protection and Switchgear, New Age International (P) Ltd., New Delhi, (2000).
9. Weedy, B.M., "Electric Power Systems", 3rd ed., John Wiley & Sons, (1989).
10. Davies, T., Protection of Industrial Power Systems, Pergamon Press, (1984).

EEK372/3 - Power Systems Analysis

Objectives: To analysis of electric power systems using system modelling for electrical power networks; admittance and impedance matrix formation; power flow analysis; symmetrical components; balanced and unbalanced fault analysis; and transient stability studies.

Synopsis: This course provides knowledge of an elctrical power system analysis by using an electrical power system modeling. In this course presented and discussed of electrical power system system generally, parameters and modeling of the generation (synchronous generators and alternators), transformer, transmission and line transforse and distribution and also characteristic and types of load. In this course also discussed the calculation and analysis of electric power flow with various methods such as Newton-Raphson, Gaussidel and Fastdecouple method. Also discussed the calculation and analysis of fault current for balanced and unbalanced three-phase faults (phase-to ground faults, two phase to ground faults and phase-to-phase faults). In this course also analyzed the system stability of an electric power system (dynamic stability and transient stability). Calculation method and analysis conducted by using any computer programming.

Basic Principles of Power System Analysis
Power on Three-Phase System, Complex Power, Per-Phase Analysis, Power Factor Correction, Single Line Diagram of the Power Network and Per Unit System.

Power System Parameter and Modelling
Synchronous Generator Model and Parameters, Model and Parameter of Transformers, Transmission line Parameters (R, L and C), Transmission line Models (Short, Medium and Long Models), Loads Model.

Power Flow Analysis
Power System Representative, Bus Admittance Matrix, Gauss-Seidel Iterative Solution and Newton-Raphson Method for Power Flow analysis. Fast Decouple Power Flow Solution.

Fault and Short Circuits Analysis
Transient Phenomena, Balanced Fault, Short-Circuit Capacity (SCC), Bus Impedance Matrix, Symmetrical Components, Sequence Impedance and Networks, Unbalance Faults and Short Circuit Analysis (L-G, L-L, L-L-G and 3-phase Faults).

Transient and Stability Analysis
Swing Equation, Synchronous Machine Model for Stability Analysis, Steady-State Stability for Small Disturbances, Transient Stability Equal Area Criterion.

Laboratory
Experiments and simulation conducted on power system analysis (Generator, transformer, transmission, loads, real power, reactive power, complex power, power flow analysis, faults analysis and transient stability analysis

Course Outcomes:
CO1: Able to define the parameters and modelling of power system
CO2: To be able to analyze power flow and fault occurrence in electrical power system
CO3: To be able to evaluate and analysis system stability in electrical power system

References:

1. Hadi Saadat, Power System Analisis", Third Edition, McGraw-Hill, (2012).
2. Grainer and Stevenson Jr., "Power System Analysis", McGraw Hill, 1994
3. J. Duncan Glover, Mulukutla S. Sarma and Thomas J. Overbye., " Power System Analysis and Design"., 5th Edition, Thomson, (2015)
4. D. P. Kothari and I. J. Nagrath, ' Modern Power System Analysis" Third Edition, Tata McGraw-Hill 2005.

EEK373/4 – Advanced Power Electronics

Objective: This course offers students to learn various kinds of power electronics circuits and their related applications such as rectifiers, ac controllers, inverters, resonant converters and switch mode power supplies.

Synopsis: This course offers for students to learn various kinds of power electronics circuits and their related applications such as rectifiers, ac controllers, inverters, converters and SMPS.

Controlled Rectifiers
Single phase half wave rectifiers with inductive resistive and battery loads, Single phase full-wave rectifiers with inductive resistive and battery loads, single-phase semi-converters, three-phase full converts, three-phase semi- converters, effect of load and source inductances, power factor, harmonic for inductive and resistive load dc load.

AC Voltage Controller

Duty cycle control, single phase full-wave controller with resistive and inductive load, multiphase ac controller with resistive and inductive load, transformer tap changers, cycloconverter, ac voltage controller with PWM control, design of ac voltage controller circuit.

Inverter

Performance parameters, single-phase inverter operation, single-phase half bridge, full-bridge inverters and push pull inverters, voltage control of single-phase inverter, three-phase inverters with 120 and 180 degree conduction, inverter switching circuits, harmonic reduction techniques.

DC-DC Converters

Performance parameters of dc-dc converters control of dc converter, principles of step down and step up operations, Buck converter, Boost converter, Buck-Boost converter, Cuk Converter, design consideration for dc-dc converters, comparison of dc-dc converters.

Resonant Converter

Basic concept of resonant circuits, types of resonant converter, series resonant inverters with unidirectional and bidirectional switches, parallel resonant inverters, load resonant converters, frequency response of series, parallel and series-parallel resonant inverters, zero voltage switching (ZVS) converters, zero current switching (ZCS) converters.

Power Supplies

Linear dc power supplies, switched mode dc power supplies, resonant and bidirectional dc power supplies – switched mode ac power supplies resonant ac power supplies and bidirectional and bidirectional ac power supplies.

Laboratory and Simulation

Experiments on single/three phase controlled rectifiers, ac voltage controllers, dc-dc converters and switch mode inverters.

Course Outcomes:

CO1: Able to describe the function and operation of common power electronics systems

CO2: Able to perform the steady-state analysis of power electronics converter systems

CO3: Able to design and evaluate the performance of power electronics converter systems

References:

1. Rashid, M H., "Power Electronics: Circuit, Devices & Applications", Prentice Hall, 4th Edition, 2014.
2. Mohan, Underland, and Robbins, "Power Electronics: Converter, Applications & Design", John Wiley, 3rd Edition, 2003.

3. Moorthi, VR, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford University Press, 2005.

EEK425/3 - Electrical Engineering Design

Objective: To expose and reinforce knowledge and skills in the management aspects of the design and the implementation of integrated electrical engineering and complex engineering problem, covering various technical aspects, safety, culture, community, and environmental well-being. To develop the ideas, knowledge and skills within the framework of projects plans that systematically (electrical engineering design) and implemented in an electrical engineering design.

Synopsis: The course comprises solving complex engineering problem by designing viable solutions that integrates components in core areas of Electrical Engineering and meeting specific needs with appropriate considerations such as sustainability, public health and safety, society, cultural dan environment issues.

Course Outcomes:
CO1: Ability to identify the relevant solutions, methodologies, and theories used to solve Electrical Engineering design problems
CO2: Ability to select, apply, adapt, and innovate the relevant solutions, methodologies, and theories for designing Electrical Engineering systems by taking into account the safety and well-being of the environment and society
CO3: Ability to create effective teamwork in solving complex Electrical Engineering design problems involving technical, financial, ethical, management, environmental, and societal aspects.

References:
1. Nigel J. Smith, "Engineering Project Management," Mc Graw-Hill, New York, (2007).
2. Lionel B. Roe, "Practical Electrical Project Engineering," Pearson Prentice Hall, New York, (2013).
3. Paul Scherz, "Practical Electronic For Inventors – Third Edition", McGraw Hill Professional (2013)
4. Fink and Beaty, "Standard Handbook for Electrical Engineers", Fourth Edition, Mc Graw-Hill, New York, (2012).
5. Philippe Coussy and Adam Morawiec, "High-level Synthesis: From Algorithm to Digital Circuit", Springer (2008)
6. Kim R., "Design Concepts for Engineers", Prentice Hall (2010)
7. Peter Wilson and H. Alan Mantooth, "Model-Based Engineering for Complex Electronic Systems", Newnes (2013).

8. Oliver L. de Weck, Daniel Roos, Christopher L. Magee and Charles M. Vest, "Engineering Systems: Meeting Human Needs in a Complex Technological World", The MIT Press (2011)
9. B. S. Dhillon, "Safety Fowler, "What Every Engineer Should Know About Developing Real-Time Embedded Products", CRC Press (2008)
10. John Okyere Attia, "PSPICE and MATLAB for Electronics: An Integrated Approach", CRC Press (2010)
11. Krzysztof Iniewski, "Embedded Systems: Hardware, Design, and Implementation", John Wiley & Sons (2012)
12. Sammy G. Shina, "Six Sigma for Electronics Design and Manufacturing", McGraw Hill Professional, (2002)
13. Mark N. Horensteinand Human Error in Engineering Systems", CRC Press (2012)
14. Obaidat, Anpalagan and Woungang, "Handbook of Green Information and Communication Systems", Academic Press (2012)

EEK468/3: Electrical Machines Drives

Objective: This course is offered to provide sound knowledge of electrical machines and drives with necessary information on the use of solid-state converters, choppers and inverters. The course delivery consists of three hours lecture per week.

Synopsis: This course will discuss theory, concepts and control principles for electrical machines and drives with the use of solid-state power electronics converters, choppers and inverters.

Introduction to Electric Drive Systems
Conventional electrical drive system, basic components of a modern electric drive system, bidirectional electrical drive systems, four quadrant electrical drive systems.

DC Machines
EMF, voltage and torque equations, losses and efficiency, ideal characteristics for separately excited, series, shunt machines.

AC Machines
Introduction to voltage and torque equations, armature reaction, excitation and voltage regulation, synchronous machines (phasor diagram, characteristics, equivalent circuit, saliency, synchronous reluctance motors), induction machines (equivalent circuit, characteristics, speed control), linear motors.

DC Drive Systems
Control using DC choppers and phase angle controlled rectifiers, dynamic equations, computer simulation.

AC Drive Systems
Three-phase bridge inverter, variable speed inverter-fed induction and synchronous motor drives, computer simulation, and concept of vector control.

Small Motor Drive Systems
Hybrid-stepping motors (characteristics and control), trapezoidal and sine wave brushless DC drives, switched reluctance drives, AC commutator motors (small).

Course Outcomes:
CO1: Able to define the basic components of electrical drive systems, the operation of various types of DC and AC motors, and the fundamental concept of different types of DC and AC drive systems.
CO2: Able to analyse the characteristics of various types of electrical motors and also electrical drive systems.
CO3: Able to evaluate the performance of various types of electrical motors and also of electrical drive systems.

References:

1. Mohammed A. El-Sharkawi, "Electrical Machines and Drives", Brooks/Cole, (2000).
2. Juha Pyrhonen, Tapani Jokinen and Valeria Hrabovcova, "Design of Rotating Electrical Machines", Wiley, (2008).
3. Theodore Wildi, "Electrical Machines, Drives and Power Systems", Prentice Hall, 6/e, (2006).
4. Ion Boldea and Lucian Tutelea, "Electric Machines: Steady Stae, Transients, and Design with Matlab", CRC Press, (2010).

EEK470/4 – Electrical Power Distribution Systems

Objective: This course covers the analysis, design and protection of the electrical power distribution systems

Synopsis: This course is offered to provide sound knowledge and analysis about power distribution system including classifications of utility loads, brief review on distribution transformer and power factor correction. This includes the design and the study of: (1) Sub-transmission line and distribution on substation, voltage drop and voltage regulation, K factor and substation grounding. (2) Main distribution system which includes various types of feeders, voltage levels, system growth scheme, uniform and non-uniform radial feeders. (3) Secondary distribution system design

including discussion on secondary feeders, voltage levels, secondary networks and economic considerations (4) Voltage drop and power loss calculation, balanced three-phase and non-three-phase main system and four-wire three-phase multi-grounded system (5) Voltage regulation of distribution systems. (6) Power distribution system protection.

Fundamental Consideration
Fundamental of power distribution, classifications of utility loads, loads characteristics, utility factors and various transmission and distribution voltage levels.

Design of Sub-transmission Line and Distribution on Substation
Subtransmission line, substation rating, substation bus schemes, service area, voltage drop and voltage regulation, K factor and substation grounding.

Design of Main Distribution System
Discussion on various types of feeders (radial, loop, network), voltage levels, system growth scheme, voltage drop on feeders with different loadings (uniform, increasing, decreasing), examples of radial main distribution system design.

Secondary Distribution System Design
Discussion on secondary feeders, voltage levels, secondary networks and economic considerations of secondary system design.

Voltage Drop and Power Loss Calculation
Balanced three-phase and non-three-phase main system, four-wire three- phase multi-grounded system and feeders cost analysis.

Voltage Regulation of Distribution Systems
Service quality and voltage standard, the need for regulation commission, voltage control, voltage regulator and tap-changers, applications of regulator and capacitors and voltage profiles.

Distribution System Protection
Discussion on protection concepts, types and characteristics of protection devices, protection devices coordination, lightning and substation protection and fault current calculation.

Laboratory
Application of simulation software packages in regulation study for distribution systems, experiments on balanced and unbalanced loads for 3- wire and 4-wire three phase systems and coordination of system protection.

Course Outcomes:

CO1: Able to determine the basic components of electrical power distribution systems and standardizations.

CO2: Able to analyze the characteristics of the electrical power distribution system and its protection system.

CO3: Able to evaluate the performance of electrical power distribution systems and the design of primary and secondary power distribution system.

References:

1. Gonen, T., "Electric Power Distribution System Engineering", CRC press, (2014).
2. Faulkerberry, L.M., and Coffer,W., "Electrical Power Distribution and Transmission", Prentice Hall, New Jersey, (2006).
3. Burke, J.J., "Power Distribution Engineering Fundamentals and Applications", Mercel Dekker, Inc., New York, (2004).

EEK474/4- Electrical Machines Design

Objective: This course is offered to provide sound knowledge and design ideas on engineering materials, magnetic circuits, electromagnetic aspects of machine design, electrical, mechanical and thermal design constraints, types of windings, arrangements of windings and motor dimensions and sizing. Case studies on a static machine viz. transformer and a rotating machine viz. a permanent magnet brushless motor will provide insight to the student to take up mini project on the design of electrical machines using finite element software.

Synopsis: This course is offered to provide sound knowledge and design ideas on engineering materials, magnetic circuits and electromagnetic aspects of electrical machine designs. It also discusses the electrical, mechanical and thermal design constraints, types of windings, arrangements of windings and motor dimensions and sizings. Motor modeling and simulation on a static machine viz. transformer and rotating machine viz. permanent magnet brushless motor will provide detail insights to student on design issues using finite element software Opera2D.

Introduction

Design considerations, design factors, design limitations, trends in design of electrical machines, modern electrical machine manufacturing techniques.

Materials for Electrical Machines

Properties and characteristics: electrical conducting materials, soft magnetic materials, hard magnetic materials, electrical insulation materials, temperature limits, electrical and mechanical constraints.

Magnetic Circuit

Basic principles of magnetic circuit, magnetization curve, leakage and coupling field, flux and inductance, B-H curve of permanent magnet, load line and working point.

Heating and Cooling of Electrical Machines

Heat dissipation: conduction, radiation and convection; Cooling: terminologies, method of cooling (natural cooled, forced cooling etc.); Temperature rise: time constant, steady state temperature rise; Rating of electrical machine: power ratings, types of duties and ratings, ambient temperature and rating, overload capacity of machines, rapid heating of conductor.

Winding Design

Types of winding configuration: concentrated, distributed, overlapping and non-overlapping windings, double-layers, MMF and EMF of winding, winding factors: chording, distributing and skewing factors, torque constant and EMF constant, construction, packing factor, end windings, phase inductance, mutual inductance.

Case study / Mini Project

Design example of transformer, permanent magnet brushless motor and/or induction motor using 2d finite element software.

Course Outcomes:

CO1: Able to describe and analyze magnetic circuits, material characteristics, mechanical properties and energy conversion process in electrical machines

CO2: Able to describe typical winding arrangements in electrical machines

CO3: Able to synthesize a design example for dc machines and AC machines.

References:

1. Duane Hanselman., "Brushless Permanent Magnet Motor Design", The Writers' Collective, Cranston, Rhode Island USA, (2003).
2. Theodore Wildi., "Electrical Machines, Drives and Power Systems", Prentice Hall, 6/e, (2006).
3. Ion Boldea and Lucian Tutelea, "Electric Machines: Steady Stae, Transients, and Design with Matlab", CRC Press, (2010).
4. Juha Pyrhonen, Tapani Jokinen and Valeria Hrabovcova, "Design of Rotating Electrical Machines", Wiley, (2008).
5. JR Hendershot Jr and TJE Miller, "Design of Brushless Permanent-Magnet Motors", Magna Physics Publishing and Clarendon Press, Oxford, (1994).

EEK475/4 – Economic and Power Systems Management

Objective: To learn the economic and management aspects of electrical energy systems.

Synopsis: This course is offered to learn and study the analysis of economics and management on electric power system. This will includes power energy supply economic, economic aspect of power systems, break-even point of the power plant, value decrease analysis of the equipment and component power system, profit index, demand and supply ratio. In addition, load Forecast and Energy Cost, Loads characteristics, structure and tariff, Power System Economic Operation, power auditing analysis, power quality aspect and harmonics and their effects on power system were also covered.

Energy Supply Economic
Introduction of economic engineering, economic aspect of power systems, break-even point of the power plant, value decrease analysis of the equipment and component in power system, profit index, demand and supply ratio.

Loads Forecast and Energy Cost
Loads characteristic, load growth forecast, supply and demand, structure and rate level, electric energy measurement, saving energy by supplier and consumer.

Power System Economic Operation
Principles of economic distribution, scheduling of power generator units, losses in distribution and transmission lines, power system component, load sharing by power station.

Power System Management
Power system management and optimization power generating units, power auditing analysis, increase the quality of the power station, harmonics and their effects on power system.

Reliability in Power System
Probability concept and reliability model, analytic method in probability, finding the chance value using probability distribution and finding reliability of the power system.

Laboratory

Using computer software/tools to study economic analysis in power system.

Course Outcomes:

CO1: To be able to define the parameters of economic engineering and management on electrical power system

CO2: To be able to analyse loads forecast, optimisation and electric energy management, sustainability in power system

CO3: To be able to evaluate the system quality of power, reliability and auditing of power system

References:

1. Hadi Saadat, "Power System Analysis", 3rd Edition", Mc Graw-Hill, New-York, 2008.
2. Alexanddra,"Electric Power System-A Conceptual Introduction", John Wiley & Son, USA, 2006
3. Stevenson Jr., "Power System Analysis", Mc Graw-Hill, New- York, 2004
4. Theodore Wildi, "Electrical Machines, Drives and Power Systems", Pearson, Prentice Hall, 2006, New York, 2002.

EEK477/4 – Renewable Energy

Objective: This course is offered to provide a relevant knowledge of various types renewable energy, operations, applications and return revenue of the renewable energy system. The course will be focused on two main types of renewable energy such as solar energy and wind energy.

Synopsis: Renewable energy course provides an introduction to the types of renewable energy, basic features and engineering technology for energy production. The primary focus is on two major renewable energy, namely solar PV and wind power. The solar PV section covers the basic theory, fabrication processes, types of PV panels, application, sizing and return of investment. The wind energy section covers the basic fan theory, turbine types, electricity generation and wind power system disadvantages. In addition, an emphasis will also be placed on energy storage technologies, power distribution and renewable energy policy.

Introduction to the types of renewable energy

Introduction to types of renewable energy; solar energy PV, solar thermal, wind energy, hydro energy, biomass and wave energy.

Solar Energy PV

Semiconductor technology, cell fabrication process and silicone panel, type of PV panel, and I-V curve

Solar Energy PV 2

STC, Panel orientation angle, PV system component, application and generation size, return of investment

Wind Energy

Type of turbine and operation criterion, linear momentum and basic theory, dynamic similarity, theory of fan, wind characteristics, turbine power extraction, electrical generation, mechanical power, problem of wind power system

Energy and storage system

Importance of energy storage and distribution, biology storage, chemical storage, thermal storage, electrical storage: acid battery plumbum, fuel cell, mechanical storage

Integration of renewable energy

Stand-alone system and grid support, policy, Fit incentive, Nett metering, energy distribution, electrical power, social and environment

Course Outcomes:

CO1: Able to explain basic characteristics and diversity of the types of renewable energy system

CO2: Able to analyze the energy efficiency and the optimum energy generation from the renewable energy system.

CO3: Able to assess the development and the economy return of renewable energy system

References:

1. Solar Energy: The physics and engineering of photovoltaic conversion, technologies and systems, (2016).
2. Renewable energy resource, by John Twidell and Anthony Weir, (2006)
3. Fundamentals of renewable energy processes, by Aldo da Rosa, (2009)
4. Understanding renewable energy systems, by Volker Quaschning, (2004)

EEK499/6- Undergraduate Project

Objective: A small scale research project will be undertaken by every final year student. The aim of the project is to train the student identify some problems related to electrical engineering and introducing them with the techniques of investigation, solving problems , writing a technical report and presentation of the results in the form of thesis and seminar.

Course Outcomes:

CO1: To be able to design, implement, execute and synthesize a solution for a given engineering problem using the inherent tools of engineering.

CO2: To be able to plan, organize, construct and utilize systems approach in undertaking an engineering project and able to apply in depth knowledge of a technical topic and practical aspects of engineering.

CO3: To be able to express, justify and defend their ideas and information in terms of written and oral form according to professional and ethical practices.

CO4: To be able to apply their personal generic capabilities via holistic approaches in accomplishing the goal throughout the whole process.

STRUKTUR IJAZAH SARJANA MUDA (KEPUJIAN) KEJURUTERAAN MEKATRONIK
BACHELOR'S DEGREE IN ENGINEERING (HONS) MECHATRONIC ENGINEERING STRUCTURE

7.0

	100				200				300				400			
	Semester 1		**Semester 2**		**Semester 3**		**Semester 4**		**Semester 5**		**Semester 6**		**Semester 7**		**Semester 8**	
TERAS *(CORE)*	**EUM113/3 Kalkulus Kejuruteraan** *(Engineering Calculus)*	Cuti Pertengahan Semester *(Mid Semester Break)*	**EUM114/3 Kalkulus Kejuruteraan Lanjutan** *(Advanced Engineering Calculus)*	Cuti Panjang *(Long Vacation)*	**EEE232/3: Analisis Kompleks** *(Complex Analysis)*	Cuti Pertengahan Semester *(Mid Semester Break)*	**EEM253/2 Rekabentuk Mekatronik I** *(Mechatronic Design I)*	Cuti Panjang *(Long Vacation)*	**EEM355/3: Sistem Mekatronik** *(Mechatronic Systems)*	Cuti Pertengahan Semester *(Mid Semester Break)*	**EEM323/3 Sistem Peralatan & Pengukuran** *(Instrumentation And Measurement Systems)*	EEL303/5 Latihan Industri *(Industrial)*	**EEM441/2 Makmal Peralatan & Kawalan** *(Instrumentation And Control Lab)*	Cuti Pertengahan Semester *(Mid Semester Break)*	**EEM499/6 Projek Prasiswazah** *(Undergraduate Project)*	
	EMD101/2 Lukisan Kejuruteraan *(Eng. Drawing)*		**EEE125/3 Makmal Asas Litar** *(Basic Circuit Lab)*		**EEM242/2 Makmal Mekatronik I** *(Mechatronic Lab I)*		**EEE226/3 Mikropemproses I** *(Microprocessor I)*		**EEK361/3 Elektronik Kuasa** *(Power Electronics)*		**EEE354/3 Sistem Kawalan Digit** *(Digital Control Systems)*		**EEM422/2 Penglihatan Mesin** *(Machine Vision)*		**EEM421/4 Kaedah Kualiti** *(Quality Techniques)*	
	EEM102/2 Amalan Kej. Mekatronik *(Mechatronic Eng. Practice)*		**EEE130/3 Elektronik Digit I** *(Digital Electronic I)*		**EEE241/3 Elektronik Analog I** *(Analog Electronics I)*		**EEK260/3 Mesin Elektrik** *(Electrical Machines)*		**EEE350/3 Sistem Kawalan** *(Control Systems)*		**EUP222/3 Jurutera Dalam Masyarakat** *(Engineer In Society)*		**EEM425/3 Rekabentuk Sistem Mekatronik** *(Mechatronic System Design)*			
	EEE105/3 Teori Litar I *(Circuit Theory I)*		**EMM102/3 Statik** *(Static)*		**EEE228/3 Isyarat & Sistem** *(Signal And System)*		**EEM222/4 AsasDinamik & Mekanisma** *(Fund. Of Dynamics & Mechanisms)*		**EEE382/3: Kebarangkalian & Statistik Kejuruteraan** ***(Probability & Engineering Statistics)***		**EEM344/2 Makmal Mekatronik II** *(Mechatronic Lab II)*					
	EEE123/3 Pengaturcaraan Komputer Utk Jurutera *(Computer Programming For Engineers)*		**EEE133/3 Peranti & Litar Elektronik** *(Electronic Devices & Circuit)*		**EEM223/3 Termobendalir** *(Thermofluids)*				**EEM353/3: Rekabentuk Kejuruteraan Mekanik** *(Mechanical Engineering Design)*		**EEM343/3 Robotik** *(Robotics)*					
	EEM101/3 Prinsip & Mekanik Bahan *(Principles And Mechanics Of Materials*															
	16		**15**		**14**		**12**		**15**		**14**	**5**	**7**		**10**	**108**
KEP. UNIV. *(UNIV REQ.)*	**LKM 400/2** B.Malaysia *(Malay Language)*		**WUS101/2: Teras Keusahawanan** *(Core Entrepreneurship)*		**LSP/2: B. Inggeris** *(English Language)*		**HTU223/2 :TITAS** *(Islamic and Asian Civilisations)*		**LSP/2: B. Inggeris** *(English Language)*						**OPSYEN/3** *(Option/3)*	**15**
							SHE101/2 Hubungan Etnik *(Ethnic Relations)*									
ELEKTIF *(ELECTIVE)*	**Catatan** ***(Note)*****:** **Pilih SATU kursus Elektif pada Semester 6 dan Sebarang DUA kursus Elektif pada Semester 7** ***(Choose ONE Elective course from Semester 6 and any TWO Elective courses from Semester 7)***										**EEM348/4 Prinsip Sistem Pintar** *(Principle Of Intelligent Systems)*		**EEM423/4 Kejuruteraan Kebolehpercayaan** *(Reliability Eng.)*			**12**
											EEM 354/4 Pengurusan Dan Teknologi Pembuatan *(Manufacturing Management and*		**EEM424/4 Rekabentuk Ujikaji** *(Design of Experiments)*			
													EEE453/4 Rekabentuk Sistem Kawalan *(Control System Design)*			
													EEE430/4 Kej. Perisian *(Software Engineering)*			
Jumlah Unit per Semester	18		17		16		16		17		18	5	15		13 10 (tanpa opsyen)	135
	JUMLAH UNIT MINIMUM BAGI PENGIJAZAHAN ***(TOTAL MINIMUM UNIT FOR GRADUATION)***															**135**

BACHELOR OF ENGINEERING (HONOURS) (MECHATRONIC ENGINEERING)

7.1 CURRICULUM

LEVEL 100

		Credit	Contact Hours	
		Total Unit	Lecture	Lab/ Tutorial
Semester I				
EEE105/3	Circuit Theory 1	3	3	1
EEE123/3	Computer Programming for Engineers	3	2	2
EEM102/2	Mechatronic Engineering Practices	2	0	4
EMD101/2	Engineering Drawing	2	0	4
EUM113/3	Engineering Calculus	3	3	1
EEM101/3	Principles and Mechanic of Materials	3	3	1
		16	**11**	**13**
SEMESTER BREAK				
Semester II				
EEE125/3	Basic Circuit Laboratory	3	0	6
EEE130/3	Digital Electronics 1	3	3	1
EEE133/3	Electronic Devices & Circuit	3	3	1
EMM102/3	Statics	3	3	1
EUM114/3	Advanced Engineering Calculus	3	3	1
		15	**12**	**10**
LONG VACATION				

LEVEL 200

		Credit	Contact Hours	
		Total Unit	Lecture	Lab/ Tutorial
Semester I				
EEE228/3	Signals & Systems	3	3	1
EEE232/3	Complex Analysis	3	3	1
EEE241/3	Analogue Electronics I	3	3	1
EEM223/3	Thermofluids	3	3	0
EEM242/2	Mechatronic Laboratory I	2	0	4
		14	**12**	7
SEMESTER BREAK				
Semester II				
EEM253/2	Mechatronic Design I	2	1	2
EEE226/3	Microprocessors I	3	2	2
EEK260/3	Electrical Machines	3	3	1
EEM222/4	Funds. of Dynamics and Mechanisms	4	4	1
		12	**10**	**6**
LONG VACATION				

LEVEL 300

		Credit	Contact Hours	
		Total Unit	**Lecture**	**Lab/ Tutorial**
Semester I				
EEM355/3	Mechatronic System	3	3	0
EEK361/3	Power Electronic	3	3	1
EEE350/3	Control Systems	3	3	1
EEE382/3	Probability & Engineering Statistics	3	3	1
EEM353/3	Mechanical Engineering Design	3	3	0
		15	**15**	**3**
SEMESTER BREAK				
Semester II				
EEM323/3	Instrumentation and Measurement Systems	3	3	1
EEE354/3	Digital Control Systems	3	3	1
EUP222/3	Engineers in Society	3	3	0
EEM344/3	Mechatronics Laboratory II	2	0	4
EEM343/3	Robotics	3	3	1
		14	**12**	**7**
Elective				
EEM348/4	Principles of Intelligent Systems	4	3	2
EEM354/4	Manufacturing Management and Technology	4	4	0
EEL 302/5	Industrial Training (10 weeks)	**5**	**0**	**10***
LONG VACATION				

LEVEL 400

		Credit	Contact Hours	
		Total Unit	**Lecture**	**Lab/ Tutorial**
Semester I				
EEM441/2	Instrumentations and Control Laboratory	2	0	4
EEM422/2	Machine Vision	2	2	1
EEM425/3	Mechatronics System Design	3	1	4
		7	**3**	**9**
Elective				
EEM423/4	Reliability Engineering	4	3	2
EEM424/4	Design of Experiments	4	3	1
EEE453/4	Control Systems Design	4	3	2
EEE430/4	Software Engineering	4	3	2
SEMESTER BREAK				
Semester II				
EEM421/4	Quality Techniques	4	4	0
EEM499/6	Undergraduate Project	6	0	12
		10	**4**	**12**
LONG VACATION				

7.2 COURSE - PROGRAMME OUTCOMES MATRIX

				EMPHASIS TO THE PROGRAM OUTCOMES											
				PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
COURSE CODE		SEM	DESCRIPTION												
Level 100															
1	EEM101	1	Princ. and Mechanics of Materials	X	X										
2	EEM102	1	Mechatronic Eng. Practice					X					X		
Level 200															
3	EEM242	3	Mechatronic Lab 1			X					X	X	X		
4	EEM223	3	Thermofluids	X	X										
5	EEM253	4	Mechatronic Design 1	X		X		X					X		
6	EEM222	4	Funds. of Dynamics & Mechanisms	X	X	X									
Level 300															
5	EEM355	5	Mechatronic Systems	X	X										
6	EEM353	5	Mechanical Engineering Design	X	X	X						X	X		
7	EEM323	6	Instrumentation and Measurement Systems	X	X	X		X				X			
8	EEM344	6	Mechatronic Lab II				X				X	X	X		
9	EEM343	6	Robotics	X	X	X		X		X					
10	EEM348	6	Principle of Intelligent System	X	X			X							
11	EEM354	6	Manufacturing Management & Tech.		X	X		X					X		X
Level 400															
12	EEM441	7	Instrumentation and Control Lab			X	X	X			X	X	X		
13	EEM422	7	Machine Vision	X		X		X							
14	EEM425	7	Mechatronic System Design			X			X	X		X	X	X	X
15	EEM423	7	Reliability Eng.	X	X	X									
16	EEM424	7	Design of Experiments		X	X	X			X				X	
17	EEM421	8	Quality Techniques		X	X					X			X	
18	EEM499	8	Undergraduate Project				X		X				X	X	X

Legend

PO1- Engineering Knowledge
Ability to apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems

PO2- Problem Analysis
Ability to identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences

PO3- Design/Development of Solutions
Ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations

PO4- Investigation
Ability to conduct investigation of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, synthesis of information to provide valid conclusions

PO5- Modern Tool Usage
Ability to create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations

PO6- The Engineer and Society
Ability to apply reasoning informed b y contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems

PO7- Environment and Sustainability
Ability to understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts

PO8 - Ethics
Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice

PO9- Individual and Team Work
Ability to function effectively as an individual, and as a member or leader in teams and in multi-disciplinary settings

PO10- Communication
Ability to communicate effectively on complex engineering activities with the 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

PO11- Project Management and Finance
Ability to demonstrate knowledge and understanding of engineering and management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO12- Life Long Learning
Ability to recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

7.3 COURSE DESCRIPTION

EEM101/3- Principles and Mechanics of Materials

Objective: To provide the engineering students the ability to analyse problems in mechanics and material engineering in a simple and logical manner.

Synopsis: This course reviews the topics on atomic structures, material characteristic, plastic and elastic behavior and phase diagram. The concept of shear and moment diagram and their relationship with stress and deflection.

Principles of Materials:
Introduction to metallic materials and their alloys, polymers, ceramic and composite structures. Phase diagram. Heat treatment. Plastic and linear behaviour of polimers, elastomer, semiconductor and magnetic material. Electrical behaviour of materials. Metalurgical Failure and non-destructive testing.

Mechanics of Materials:
Concept of Stress and Strain. Torsion. Pure Bending. Stresses and Deformations in Elastic Range. Plastic Deformation. Mohr's Circle for Plane Stress. Energy Method. Optical Technique in Stress and Strain Analysis. Introduction to Finite Element Analysis (FEA).

Course Outcomes

CO1: To be able to understand the structure of crystalline solids, the imperfections in solids and diffusion process.

CO2: To be able to understand the mechanical properties of metals, dislocation and strengthening mechanism and failure in materials

CO3: Understand the principle of stress in beam, deflection in beam and stress under torsion and analyze structures using basic principle of equilibrium.

CO4: Evaluate effect of load on structures through shear force diagrams, bending moment diagrams and deflection.

References:

1. Callister W.D., "Material Science and Engineering: An Introduction", 9th Ed., John Wiley, New York, (2014)
2. Cheng, Fa_Hwa, "Statics and Strength of Materials", McGraw-Hill, 2nd Ed, (1996)
3. Ferdinand P.B. & Russel E., "Mechanics of Materials", McGraw-Hill, 3rd Ed., (2002).
4. Hertzberg, R. (1998). Deformation and Fracture Mechanics of Engineering Materials, 3rd Edition, John Wiley.
5. Merriam, J.L. & Kraise L.G., "Engineering Mechanics (Vol 1 and 2)", John Wiley, (1987)

6. Smith, W.F., "Principles of Materials Science and Engineering", 2nd Ed., McGraw-Hill, (1990)
7. Higdon, A., "Mechanics of Materials", 4th Ed., John Wiley, New York, (1985)
8. Gere, J.M., "Mechanics of Materials", 5th Ed., Brooks/Cole, (2001)

EEM102/2- Mechatronic Engineering Practice

Objective: This course is an introduction to basic practice of electrical wiring, electrical/electronic circuit simulation and PCB fabrication as well as mechanical engineering skill such as welding, measurement, lathe and milling.

Synopsis: This course is divided to two major components: Electrical/Electronic and Mechanical components. The components are on the skill and technique on how to use PSpice and ORCAD software in simulation and design the electrical and electronic circuitry, fabrication technique for Printed Circuit Board (PCB), basic electrical wiring and mechanical engineering practice skill such as welding, measurement, lathe and milling.

Course Outcomes

CO1: To be able to draw electrical/electronic circuit using OrCAD and employ it to PCB fabrication.
CO2: To be able to implement basic electrical wiring.
CO3: To be able to apply mechanical engineering practice such as welding, measurement, lathe and milling

References:

1. Mitzner, Kraig (2011), "Complete PCB Design Using OrCAD Capture and PCB Editor", Elsevier
2. Kibbe, Richard R. White Warren T. Meyer, Roland O. , Stenerson Jon, Curran Kelly(2014), "Machine Tool Practices (10th Ed), Pearson Education
3. Hartwell F. P., Richter, H. P., Schwan, W. C. (2014), WIRING SIMPLIFIED, Park Publishing
4. Alexander Sadiku (2016), "Fundamentals of Electric circuits – 6th Edition, McGraw Hill.
5. Krar, Steve , Gill, Arthur, Smid, Peter (2014) Technology of Machine Tools 7th Edition, McGraw-Hill Education
6. Hartwell Frederic P. and Richter, Herbert P.(2014), Practical Electrical Wiring, Residential, Farm, Commercial and Industrial, 22nd edition, Park Publishing

EEM223/3 – Thermofluids

Objective: This course is intended to acquaint students with the basic concepts and applications of thermodynamics and fluid mechanics.

Synopsis: Basic concepts of thermodynamics and fluid mechanics, Laws of Thermodynamics, Properties of pure substances; Energy transfer; Static fluids; Bernoulli and Energy Equation for steady flow; Pipe flow; Continuity Equation; Momentum equation.

Course Outcomes:
CO1: To be able to understand basic definition terminology of thermofluids such as heat and fluid characteristic
CO2: To be able to identify and clarify how the theory of thermodynamics can be applied in machinery construction and understand the various classes of fluid.
CO3: To be able to explain every concept that involves the analysis model and prototype.
CO4: To be able to analyze the problem of Bernoulli's principle

References:

1. Yunus A. Cengel & Michael A. Boles, "Thermodynamics: An Engineering Approach", 8th Edition, Mc Graw Hill, (2014)
2. Crowe, C.T., Elger, D.F., Robertson, J.A., "Engineering Fluid Mechanics", 10th Edition, John Wiley, (2013)
3. Eastop, T.D, Mcconkey, A., "Applied Thermodynamics for Engineering Technologist", 5th Longman, (1993)
4. Nag, P.K, "Engineering Thermodynamics", Tata Mc Graw Hill, (1989)

EEM242/2 – Mechatronics Laboratory I

Objectives: To understand the operations of basic analog and digital electronics circuits in terms of theory, practice and typical practical circuit problems.

Synopsis: The following experiments will be conducted:

Experiments on Digital Electronics

IC Gate logic, flip-flop, synchronous and asynchronous counter, shift register, timer device, Schmitt trigger and its applications, multistable and 555 timer, comparator and multiplexer.

FPGA Project Design
Design a project using analog and digital circuits on FPGA board.

Course Outcomes:

CO1: To be able to read the specifications of the ICs, design digital circuits using flip-flops, logic gate component and construct the digital circuits for various applications.

CO2: To be able to explain characteristics of BJT, JFET and OPAMP and to be able to implement/construct basic analog components in a circuit.

CO3: To be able to use analog and digital circuits in FPGA.

References:

1. Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Pearson, (2014).
2. William Kleitz, "Digital Electronics – A Practical Approach", 8th Edition, Prentice Hall, (2008).
3. Mano, M.M., and Kime, C.R., "Logic and Computer Design Fundamentals", Prentice Hall, (1997).
4. Boylestad, R.L, and Nashelsky, L., "Electronic Devices and Circuit Theory", 7th. Edition, Prentice-Hall, (1999).

EEM253/2 – Mechatronic Design I

Objective:

1. To introduce students to the fundamental of industrial automation, Electropneumatic circuits and practical aspects of Programmable logic controller.
2. To integrate mechatronic design theories and to conduct practical experiment of mechatronic circuitries.

Synopsis: Overview of industrial automation, Industrial sensors, Fluid power actuation systems and fluid circuits, Programmable logic controllers, Ladder diagrams, Sequential Function Chart, State Chart, Process Timing Diagram, PLC addressing and instructions, Timers and counters. I/O modules and wiring,Plant floor communication

Course Outcomes:

CO1: To be able to explain the fundamental components for mechatronic system and operations for PLC-based system.

CO2: To be able to program plc, identify appropriate input and output components, wiring of the system suitable for the given PLC related problem.

CO3: To be able to design the PLC-based mechatronic systems.

References:
1. Bolton, W., Programmable Logic Controller, 6th Ed., Newnes, (2015)
2. Bolton W., Pneumatic and hydraulic system, Butterworth Heinemann, (1997)
3. Histand, M.B. & Allciatore, D.G., Introduction to Mechatronics & Measurement Systems, 3rd Ed., McGraw-Hill, (2007)
4. Petruzella, F.D., Programmable Logic Controllers, 4th Ed., McGraw-Hill, (2011)
5. Rehg, J.A. & Sartori, G.J., Programmable Logic Controllers, Prentice-Hall, (2009)
6. Stenerson, J., Fundamentals of programmable logic controllers, sensors, and communications, 3rd Ed., Prentice-Hall

EEM222/4 – Fundamentals of Dynamics and Mechanisms

Objective: This course will provide the student with fundamental concepts and principles of particle and planar rigid-body dynamics. The students are then introduced to the applications of mechanisms in mechanical engineering environment.

Synopsis: Introduction to dynamics, particle kinematics, particle kinetics, rigid body kinematics, plane rigid body movement – force and acceleration, energy and momentum methods, 3D rigid body kinetics, balancing on rotation mass, gear systems – gear tooth and gear networks, crank system and follower, mechanism – kinematics diagram, movement ability, position, velocity and acceleration analysis

Course Outcomes:
CO1: To be able to explain kinematic motion of rigid body particle using equation of motion to solve dynamic problems.
CO2: To be able to apply principles of work, energy, impulse and momentum in solving kinetic problems.
CO3: To be able to determine graphically and analytically the position, displacement, velocity, acceleration and force analysis of a bar mechanism.
CO4: To able to design and analyse graphically the kinematic synthesis of mechanisms that can be implemented in the cams and gears design

References:
1. Hibbeler, R.C., (2015), “Engineering Mechanics: Dynamics”, 14th Edition, Pearson Prentice Hall.
2. Myszka, D.H., (2011), “Machines and Mechanisms, Applied Kinematic Analysis”, 4th Edition, Pearson Prentice Hall.
3. Meriam, J.L., Kraige L.G. and Bolton J.N. (2015), “Engineering Mechanic: Dynamics”, 8th Edition, Wiley.

4. Vinogradov, O., (2000), "Fundamentals of Kinematics and Dynamics of Machines and Mechanisms", 1st Edition, CRC Press.

EEM323/3 – Instrumentation and Measurement Systems

Objective: To study measuring devices, data acquisition and interfacing.

Synopsis: **Advance Signal Analysis**:
Signal representation, Fourier transform, Weiner- Khintchine transform, Parseval teorem, probability density function, power spectrum density, signal recovery, phase modulation, autocorrelation and cross correlation techniques, encoding and decoding techniques.

Mechatronic Measurement Systems
Flow measurement, heat transfer effect, ultrasonic measurement techniques, pressure measurement, torque and force measurement, strain measurement, vibration measurement, displacement, velocity and acceleration measurement. Chemical measurement systems: ph, resistivity, conductivity, principle of katharometer and anemometer measurement systems, fluid flow and viscosity measurement.

Data Acquisition System and Interfacing
Types of interfacing, serial interfacing, handshake, asynchronous technique, interfacing using RS232 and RS 448 systems. GPIB interfacing: GPIB bus structure, protocol, GPIB handshake, bus operation and implementation of the GPIB system. Data acquisition: important elements, types of wiring, single ended and differential inputs, implementation of data acquisition system and virtual instrumentation

Course Outcomes:
CO1: To be able to define different types of signals as well as techniques to analyze them.
CO2: To be able to apply and design different techniques for the measurement of physical quantities
CO3: To be able to describe the working of data acquisition system & instrument Interfacing.

References:
1. BC Nakra and KK Chaudhry-Instrumentation, Measurement and Analysis-, Mc Graw Hill Education, (2010).
2. CS Rangan, GR Sarma and VSV Mani-Instrumentation: Device and Systems-Mc Graw Hill Education, (2009).
3. SK Singh- Industrial Instrumentation and Control-Mc Graw Hill Education, (2008).

4. Dominique Placko (2007). Fundamentals of Instrumentation and Measurement. Wiley.
5. Robert B. Northrop (2005), Introduction to instrumentation and measurements. CRC Press
6. Francis S. Tse, Ivan E. Morse (1989). Measurement and instrumentation in engineering: principles and basic laboratory experiments. Marcel Dekker Inc.
7. Alan S. Morris (2001). Measurement and instrumentation principles. Butterworth-Heinemann.
8. Carr (1996). Elements Of Electronic Instrumentation And Measurements, 3/E. Pearson Education

EEM343/3-Robotics

Objectives:
1. To introduce the fundamental of robotics and applications.
2. To provide exposure to robot mechanics, dynamics and intelligent control.
3. To provide examples of robotics applications.

Synopsis: This course provides an overview of robot mechanisms, dynamics, and controls. Topics include planar and spatial kinematics, and motion planning; control of manipulators and mobile robots, multi-rigid-body dynamics, 3D graphic simulation; actuators, and sensors; task modeling and human- machine interface. Laboratories components provide exposure to robot arm simulation software and control technique. Students will design and fabricate working robotic systems in a group-based project

Course Outcomes:
CO1: To identify the structure and mechanisms for a robotics system.
CO2: To analyze kinematic and dynamic analysis for forward and inverse mode.
CO3: To apply the required analysis in determining the system performance.
CO4: To design a robotic system to solve a robotic-assisted application.

References:
1. Peter Corke, “Robotics, Vision and Control”, Springer, (2013).
2. Spong, M.W., & Vidyasagar, M., (2006). Robot Modelling and Control, John Wiley.
3. Craig, J. J. (1989). Introduction to Robotics, (2nd ed.), Prentice Hall.
4. Fu, K. S., Gonzalez, R. C., & Lee, C. S. G., (1987). Robotics: Control, Vision, and Intelligence, McGraw-Hill
5. Fuller, J. L., (1999). Robotics: Introduction, Programming, and Projects, Prentice Hall.
6. Spong, M.W., & Vidyasagar, M., (1989). *Robot Dynamics and Control*, John Wiley.

7. Tsai, L.W., (1999). Robot analysis: The Mechanics of Serial and Parallel Manipulators, John Wiley.

EEM344/2 – Mechatronics Laboratory II

Objective: The objective of this course is to provide students the practical experience with actuator, drives, sensor, signal conditioning, control and thermofluids learnt in theory class.

Synopsis: Experiments with respects to topics in the following courses:-

a. Mechatronic Systems
- sensors and transducers
- signal conditioning
- ac and dc machines
- stepper and servo motors

b. Thermofluids
- properties of the fluids
- loss in transmissions
- fluid's measuring devices

c. Integration of mechanical, electronic and computer system

Course Outcomes:
CO1: To be able to perform variety of experiments related to mechatronics engineering.
CO2: To be able to evaluate and discuss the obtained results in systematic ways
CO3: To be able to work in group

EEM348/4 – Principles of Intelligent Systems

Objective: To learn intelligent systems through applications.

Synopsis: **Intelligent Systems Concept**
Concepts of artificial intelligent systems including expert system, neural networks, fuzzy logic, genetic algorithms and data mining

Technical Problem-Solving
Problem-solving using intelligent engines and knowledge base for expert performance, problem taxonomy, approaches to automatically acquire knowledge from human experience, approaches to automatically explain problem-solving behaviours

Intelligent System Analysis
Using software packages for case studies including simulations and applications of intelligent systems in signal processing and analysis, motor control systems, robotics and sensing.

Course Outcomes:
CO1: To be able to state and explain the knowledge on Knowledge Based Systems.
CO2: To be able to state and explain the knowledge on Fuzzy Logic and to tackle Fuzzy Inference systems.
CO3: To be able to state and explain the knowledge on Evolutionary Computation (EC).
CO4: To be able to state and explain the knowledge on Artificial Neural Network (ANN).

References:

1. Haykin, Simon (2009), Neural Networks and Learning Machines, Third Edition, Pearson.
2. N P Padhy (2005). Artificial Intelligence and Intelligent Systems, Oxford University Press, New Delhi.
3. David E. Goldberg (2005). Genetic Algorithms in Search, Optimization and Machine Learning, Addision Wesley.
4. Satish Kumar (2008). Neural Networks – A Classroom Approach, McGraw Hill.
5. V Kecman (2001). Learning and Soft Computing: Support Vector Machines, Neural Networks, and Fuzzy Logic Models, MIT Press.

EEM353/3 – Mechanical Engineering Design

Objective: The students should be able to design, analyze and select mechanical components under static and dynamic load. The student should be able to integrate mechanical components in mechanical system design based on fluid mechanics, thermodynamic and material mechanics principles.

Synopsis: Students are exposed to the design, analysis and selection of mechanical subsystem and element such as mechanical linkages, cam, gear, bearing, power transmission component and lubrication. Students are exposed to design activities, processes and techniques of simple industrial machinery or product.

Course Outcomes:
CO1: To be able to design and analyse of mechanical components
CO2: To be able to to design and analyse of types of bearing, springs, clutches and brake mechanism.
CO3: To be able to work in a team and design the products or industry mechanical tools by applying product development and processes.

References:
1. Richard G.Budynas and Keith J. Nisbett (2011). Shigley's Mechanical Engineering Design, McGraw Hill, 9th Edition.
2. Shigley, J.E., Mischke, C.R., Budynas, R.G. (2003). Mechanical Engineering Design, McGraw Hill, 7th Edition.
3. Karl T. Ulrich, Steven D. Eppinger (2008). Product Design and Development, McGraw Hill, 4th Edition.
4. Richard G. Budynas, Keith J. Nisbett (2010), Shigley's Mechanical Engineering Design, McGraw Hill, 9th Edition.
5. Collins, J.A. (2003), Mechanical Design of Machine Elements and Machines, Int Ed, John Wiley.
6. Hamrock, B.J., Schmid, S.R. and Jacobson, B. (2005). Fundamentals of Machines Elements, McGraw Hill, 2nd Edition.

EEM354/3 – Manufacturing Management and Technologies

Objective: Students are familiarized with the important aspects of modern manufacturing operations such as the various manufacturing technologies, the various manufacturing processes, and the management of production systems. In view of the fact that the manufacturing industry represents one of the important sources of employment for university graduates, knowledge of manufacturing operations among the graduates is considered important.

Synopsis: Processing Operations; Assembly Operations; Production Facilities; Manufacturing Support Facilities; Aggregate Planning and Master Production Schedule; Material and Capacity Requirements Planning; Managing Work-in-Progress; Measurement and Inspection Principles; Conventional Measuring Instruments and Gages; Group Technology;Surface Mount Technology, Microsystem Technology

Course Outcomes:
CO1: To be able to describe activities and principles and also design products and processes in manufacturing based on integrated circuit, micro-electrical mechanical system and rapid prototyping as case studies.
CO2: To be able to describe and solve issues related manufacturing systems and manufacturing support system.

References:
1. Mikell P. Groover (2016). Fundamental of Modern Manufacturing, Wiley, 6th Ed., 2016.
2. Kalpakjiau (2013). Manufacturing Engineering Technology, Pearson.

3. Oswald, P.F., and Munoz, J. Manufacturing Processes and Systems, 9th edition, Wiley, 1997

EEM 355/3 –Mechatronic Systems

Objective: To learn about components and characteristics of mechatronics systems.

Synopsis: Elements and characteristics of mechatronic systems.
Signal conditioning elements. Analog and digital signal processing. Noise types, equivalents and suppression techniques. Transducers for measuring electrical and non electrical quantities. Introduction to electric drives system. AC drive system: Inverters DC drive system: DC choppers and phase angled controlled rectifiers, brushless DC drivers induction and synchronous motor drives. Small motor drive system; Hybrid stepping motor, switched reluctance drives

Course Outcomes:
CO1: To be able to describe and relate the type, characteristics and operating principle of transducer and drive systems.
CO2: To be able to evaluate basic of transducers, signal conditioning and drive in mechatronics systems.
CO3: To be able to analyze and solve problem related to transducers, signal conditioning and drive systems.

References:
1. **W. Bolton**, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education, (2015)
2. Ali Emadi, "Advanced Electric Drive Vehicles" CRC Press, (2014)
3. Bentley, J.P., "Principles Of Measurement System", 4rd Ed., John Wiley, (2005).
4. Billingsley, J. "Essentials of Mechatronics", John Wiley, (2006).
5. Ganesh S. Hegde, "Mechatronics", Jones & Bartlett Learning, (2010)
6. **Seung-Ki Sul, "**Control of Electric Machine Drive Systems", Wiley-IEEE Press (2011)

EEM421/4 – Quality Techniques

Objective: This course examines the key quality tools that are employed in the planning, manufacturing, and quality improvement processes of manufacturing companies. Among the tools covered are the 7 basic quality tools, the 7 new quality tools, failure-mode-effect analysis (FMEA), quality costs ,and process capability analysis.

Synopsis: Definitions and Meanings of Quality; Basic Concepts of Quality; Quality System; Seven Basic QC Tools; Seven New QC Tools; Failure

Mode and Effect Analysis; Statistical Process Control; Statistical Acceptance Sampling; Process Capability Analysis; Deming Cycle; Quality Costs; Case Studies

Course Outcomes:

CO1: To be able to define and discuss terms, philosophies and phases in Quality.

CO2: To be able to analyze manufacturing problems systematically using establised problem-solving frameworks, quality tools and statistical tools.

CO3: To be able to define and discuss the principles and guidelines for designing products to facilitate the manufacturing and testing of products.

References:

1. Summers, D. (2007). Quality, 4th Edition, Prentice-Ha
2. David L. Goetsch Stanley Davis, "Quality Management for Organizational Excellence: Introduction to Total Quality", 7th Edition, Pearson, 2014
3. Montgomery et. Al. (2010). Managing, Controlling and Improving Quality, 2nd Edition, Wiley.

EEM422/2 – Machine Vision

Objective:

1. To introduce the fundamental of machine vision.
2. To provide exposure to types of cameras, lenses, lighting techniques and image processing algorithms in a machine vision system.
3. To provide examples of machine vision applications.

Synopsis:

Machine Vision
Introduction, Machine Vision Definition, Machine Vision versus Human Vision, Requirement

Image Acquisition
Lighting, Optics, Cameras, Image formation, Stereo Vision

Image Processing
Fundamental of image properties, Image processing and analysis, Image enhancement, Segmentation, Edge detection, Morphology, Template matching

Machine Vision application
Industrial Automation, Automated inspection system, Robotic Vision

Course Outcomes:
CO1: To be able to explain the fundamental concepts of machine vision.
CO2: To be able to identify and apply appropriate algorithms/techniques in machine vision subcomponent.
CO3: To be able to design machine vision system using appropriate component given the application specification.

References:

1. **Computer and Machine Vision** (Fourth Edition) Theory, Algorithms, Practicalities, ER Davies, Academic Press, (2012).
2. Machine Vision, Algorithms and Application, Carsten Steger, Markus Ulrich, Christian Wiedemann, Wiley-VCH, (2008).
3. Understanding and applying machine vision (second edition, revised and expanded), Nello Zuech, Marcel Dekker Inc, TA1634 Z94 (2000).
4. Handbook of Machine Vision, Ed Alexander Hornberg, Wiley-VCH, (2006).
5 Digital Image Processing, R. Gonzalez and R. Woods, Prentice Hall, 3rd Edition, 2008.

EEM423/4 – Reliability Engineering

Objective: This course is intended to convey to students aspects of reliability that encompasses the use of probability and statistics in engineering.

Synopsis: Basic concepts of reliability engineering; Concepts of probability and basic statistics; Lifetime modeling; Model fitting; Model selection; Reliability of Systems; Statistical Experiments; Reliability in Design; Reliability in Manufacture; Reliability Tests.

Course Outcomes:
CO1: Be able to define, explain and discuss terms in reliability engineering.
CO2: Be able to analyse reliability using system reliability models and common reliability tests.
CO3: Be able to analyse times-to-failure data (life data) using empirical methods.
CO4: Be able to propose and design a suitable lifetime distribution model for failure processes.

References:

1. Patrick P. O'Connor, Andre Kleyner (2012). Practical Reliability Engineering [edited by Hoboken], NJ Wiley.
2. Elsayed A. Elsayed (2012). Reliability Engineering, 2nd Edition, Wiley.
3. Kailash C. Kapur, Michael Pecht (2014). Reliability Engineering, Wiley.

4. Singiresu S. Rao (2014). Reliability Engineering, 1st Edition, Prentice Hall.

EEM424/4 – Design of Experiments

Objective: This course acquaints the students with the principles and techniques for planning and designing experiments in a systematic and scientific manner. The advantages of such techniques as compared to the traditional means which are currently employed in the manufacturing industry will be emphasized.

Synopsis: Introduction to basic principles and strategies of experimentation; Simple Comparative Experiments; Randomized Design; Paired Comparison Design; Experiments for Comparing Several Treatments; Random Effects Model; Fixed Effects Model; Completely Randomized Design; Randomized Complete Block Design,Multi-factor Experiments; Two-Factor Factorial Designs; General Factorial Designs; Two-Level Factorial Designs.

Course Outcomes:
CO1: To be able to describe the procedure for planning experiments based on modern experimental designs and to be able to contrast the procedure with the traditional one-factor-at-a-time design.
CO2: To be able to analyze data and draw conclusions from modern experimental designs for comparative experiments.
CO3: To be able to analyze data and draw conclusions from modern experimental designs involving a single factor.
CO4: To be able to analyze data and draw conclusions from modern experimental designs involving two or more factors.

References:
1. Douglas Montogomy (2012). Design and Analysis of Experiments, Wiley.
2. Montgomery, D. & Runger, G., "Applied Statistics and Probability for Engineers", 6th edition, Wiley, 2013.

EEM425/3 –Mechatronic System Design

Objective: To reinforce knowledge and skill in design, management and implementation of integrated mechatronic system and to solve complex engineering problems with appropriate considerations such as sustainability, public health and safety, societal, cultural and environmental issues.

Synopsis: The course comprises solving complex engineering problem by designing viable solutions that integrates components in core areas of Mechatronics Engineering and meeting specifying needs with appropriate considerations such as sustainability, public health and safety, societal, cultural and environmental issues. Working in groups of 4-6, the students will be responsible for conceptualizing, designing, planning, building, managing and evaluating the integrated project. This course will require students to incorporate teamwork and leadership skills in multidisciplinary settings, effective communication within the group to delegate shared responsibilities, organized project management in terms of scheduling and financial planning, and engineering ethics and professionalism in the design and implementation of the project.

Course Outcomes:

CO1: Ability to identify the relevant solutions, methodologies, and theories used to solve Mechatronic Engineering design problems.

CO2: Ability to select, apply, adapt, and innovate the relevant solutions, methodologies, and theories for designing Mechatronic Engineering systems by taking into account the safety and well-being of the environment and society

CO3: Ability to create effective teamwork in solving complex mechatronic engineering design problems involving technical, financial, ethical, management, environmental, and societal aspects

References:

1. Nigel J. Smith, “Engineering Project Management,” Mc Graw-Hill, New York, (2007).
2. Lionel B. Roe, “Practical Electrical Project Engineering,” Pearson Prentice Hall, New York, 2013.
3. Paul Scherz, “Practical Electronic For Inventors – Third Edition”, McGraw Hill Professional (2013)
4. Fink and Beaty, “Standard Handbook for Electrical Engineers”, Fourth Edition, Mc Graw-Hill, New York, 2012.
5. Philippe Coussy and Adam Morawiec, “High-level Synthesis: From Algorithm to Digital Circuit”, Springer (2008)
6. Kim R., “Design Concepts for Engineers”, Prentice Hall (2010)
7. Peter Wilson and H. Alan Mantooth, “Model-Based Engineering for Complex Electronic Systems”, Newnes (2013).
8. Oliver L. de Weck, Daniel Roos, Christopher L. Magee and Charles M. Vest, “Engineering Systems: Meeting Human Needs in a Complex Technological World”, The MIT Press (2011)

9. B. S. Dhillon, "Safety Fowler, "What Every Engineer Should Know About Developing Real-Time Embedded Products", CRC Press (2008)
10. John Okyere Attia, "PSPICE and MATLAB for Electronics: An Integrated Approach", CRC Press (2010)
11. Krzysztof Iniewski, "Embedded Systems: Hardware, Design, and Implementation", John Wiley & Sons (2012)
12. Sammy G. Shina, "Six Sigma for Electronics Design and Manufacturing", McGraw Hill Professional, (2002)
13. Mark N. Horensteinand Human Error in Engineering Systems", CRC Press (2012)
14. Obaidat, Anpalagan and Woungang, "Handbook of Green Information and Communication Systems", Academic Press (2012)

EEM441/2 – Instrumentation and Control Laboratory

Objective: To conduct experiments on application of various instrumental and control techniques.

Course Outcomes:
CO1: The ability to identify and demonstrate the instruments, control systems and measurement process.
CO2: The ability to employ, design and examine the operation of devices for signal processing system and interfacing.
CO3: The ability to employ, demonstrate and design the measurement, interfacing and control using FPGA platform.

References:
1. Doebelin, E.O. (2007). Measurement System Application and Design, 6th Edition, Mc Graw Hill.
2. Holman, J.P. (2011). Experimental Methods for Engineers. 8th Edition, Mc Graw Hill.
3. Norman S. Nice (2010). Control System Engineering, John-Wiley.
4. Newton C. Braga (2003). Mechatronics Sourcebook, Thomson-Delmar Learning.
5. K. Ogata (2009). Modern Control Engineering, 5th Edition, Prentice Hall.
6. B.C. Kuo (2009). Automatic Control System, 9th Edition, Prentice Hall.

EEM499/6- Undergraduate Project

Objective: A small-scale research project will be undertaken by every final year student. To eligible for taking the project, students need to

acquire at least 90 units from all **basic/main**/elective courses (not including units acquired from university requirement courses) and complete at least six semester of studying in university (not including the additional semester). The objective of this training is to introduce to students problems related to Mechatronics field and to accustom the students to the research and problem-solving methods, writing and effective presentation of research result in the form of a thesis.

Course Outcomes:

CO1: To be able to design, implement, execute and synthesize a solution for a given engineering problem using the inherent tools of engineering.

CO2: To be able to plan, organize, construct and utilize systems approach in undertaking an engineering project and able to apply in depth knowledge of a technical topic and practical aspects of engineering.

CO3: To be able to express, justify and defend their ideas and information in terms of written and oral form according to professional and ethical practices.

CO4: To be able to apply their personal capabilities in accomplishing the goals throughout the whole process.

8.0 COMMON COURSES

8.1 COMMON COURSES OFFERED FOR STUDENTS FROM OTHER ENGINEERING'S SCHOOL

		Credit	Contact Hours	
		Total Unit	Lecture	Lab/ Tutorial
Semester I				
EEU104/3	Electrical Technology	3	3	1
EUM 113/3	Engineering Calculus	3	3	1
SEMESTER BREAK				
Semester II				
EEU104/3	Electrical Technology	3	3	1
EUM114/3	Advanced Engineering Calculus	3	3	1
LONG VACATION				

COURSE DESCRIPTION

EEU104/3 –Electrical Technology

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

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

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

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

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

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

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

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

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

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

Magnetic Circuits and Devices
Concept and laws of magnetism and analysis of transformers.

Course Outcomes:
CO1: Able to identify basic quantity and definitions of electrical units.
CO2: Able to define the basic of electricity.
CO3: Able to apply the DC, AC and transient circuit analysis principles.
CO4: Able to analyze the magnetic device, magnetic circuit and transformer.

References:

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

8.2 COMMON COURSES FROM SCHOOL OF MATERIALS & MINERAL RESOURCES

EBB 113/3 - Engineering Materials

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

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

In general, this introductory materials science and engineering course deals with the different material types (i.e., metals, ceramics, polymers, composites), as well as the various kinds of properties exhibited by these materials (i.e., mechanical, electrical, magnetic, etc.) which intended to equip the students with necessary knowledge on material science and engineering.

Course Outcomes:
CO1: Able to define different classes of engineering materials
CO2: Able to explain the electronic structure of individual atom as well as inter-atomic bonding and crystal structure of solids
CO3: Able to differentiate the types of imperfections and diffusion mechanism

CO4: Able to interpret the phase diagram and phase transformation
CO5: Able to explain thermal, optical, electrical and magnetic properties of materials

References:

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

8.3 COMMON COURSES FROM SCHOOL OF MECHANICAL ENGINEERING

EMD 101/2 – Engineering Drawing

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

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

Course Outcomes

CO1: Able to use proper and standard technique in lettering, basic geometric constructions, sketching, dimensioning methods to describe size, shape and position accurately on an engineering drawing.
CO2: Able to create orthographic projection auxiliary, sectional views, and apply 3D pictorials to choose the best view to present the drawings.
CO3: Able to produce final drawings during the design process including assembly, machine and working drawings.
CO4: Able to create 3D part and assembly drawings using CAD software.

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

EMM 101/3 – Engineering Mechanics

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

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

Course Outcomes:
CO1: Able to identify and resolve force magnitudes and vectors into components.
CO2: Able to describe and draw the free-body diagram and to solve the problems using the equations of equilibrium.
CO3: Able to define the system of forces and moments and calculate the resultants of force using the concept of equilibrium system.
CO4: Able to identify and calculate the centroid, centre of gravity and area moment of inertia.
CO5: Able to describe the motion of a particle in terms of kinematics.
CO6: Able to apply equation of motion in solving dynamics problems.
CO7: Able to apply the principles of energy and momentum in solving dynamics problems.

References:
1. Hibbeler, R.C (2009). Engineering Mechanics: Statics and Dynamics, 12th Edition, SI units Prentice Hall.
2. Meriam, J.L. and Kraige, L.G. (1998), Engineering Mechanics: Statics and Dynamics', 4th Edition, Wiley.
3. Beer, F.P. and Johnston Jr.E.R. (2004).Vector Mechanics for Engineers: Statics and Dynamics, 7th ed., SI Units, Mc Grawc Hill.

EMM 102/3 – Statics

Objective: To provide the students with the basic knowledge in the mechanics of rigid body, especially in the concept of statics and strength of materials. Emphasis is on the understanding of free-body diagram and force vector to analyse the static force system in 2D and 3D equilibriums.

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

Course Outcomes:

CO1: Able to express and resolve the position and force into vector unit components.

CO2: Able to define the system of forces and moments and calculate the resultants of force using the concept of equilibrium system.

CO3: Able to draw and describe the free-body diagram and to solve the problems using the equations of equilibrium.

CO4: Able to determine the forces in the members of trussess and frames using the method of joints and sections.

CO5: Able to determine to the location of center of gravity and centroid for a system and to determine the moment of inertia for an area.

CO6: Able to define normal, shear, bearing and thermal stresses and deformation of axially loaded members, and able to express the stress-strain diagram.

References

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

8.4 COMMON COURSE FROM SCHOOL OF CIVIL ENGINEERING

EUP222/3 - Engineer in Society

Objective: This course aims to provide basic knowledge and understanding of the principles needed by engineers from the public involvement aspect of the community to addree issues related to ethics and law, engineering and financial management and effective project management. This course will require the direct involvement of engineers in solving real projects through critical thinking and creative team work and effective.

Synopsis: This course provides an introduction to the fundamental principles on project and financial management, ethics and laws related to environment and Occupational Safety and Health Act (OSHA), professional practice as well as the 10 commandments of project management. Problem solving through success or failure of actual case studies are reviewed.

Course Outcomes:

CO1: Explain basic principles in project management and engineering ethics.
CO2: Explain basic principles of law related to scope task of an engineer.
CO3: Determine project capability from financial aspect.
CO4: Principles project management, law, ethic and project finance in settling problem in engineering.

References:

1. Merna, A., Chu, Y. and Al-Thani, F.F (2010).Project Finance in Construction: A Structured Guide to Assessment, Wiley-Blackwell.
2. Pretorius, F., Lejot, P., Mclnnis, A., Arner, D. and Hsu, B.F.C (2009). Project Finance for Construction and Infrastructure: Principles and Case Studies, Blackwell Publishing, 2nd Edition.
3. Sears, S.K., Sears, G.A. and Clough, R.H. (2008). Construction Project Management: A Practical Guide to Filed Construction Management, Wiley, 5th Edition.
4. Chapman, C. and Ward, S. (2002). Project Risk Management: Processes, Techniques and Insights, Wiley, 6th Edition.

9.0 INDEX

10.0 STUDENTS' FEEDBACK

The aim of this feedback form is to obtain students' response regarding the contents of this Guidebook. The information obtained will be useful in improving it.

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

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

1. This Guidebook is very useful.

1	2	3	4

2. The information provided in this Guidebook is accurate.

1	2	3	4

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

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

1	2	3	4

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

1	2	3	4

5. I prefer to use CD compared to this Guidebook.

1	2	3	4

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

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

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

Distributed by:
Division of Academic & International Affairs
Universiti Sains Malaysia, 11800 USM Penang.
T: 04-653 3888 ext. 2430 / 2597 / 2346
F: 04-656 6699

Cover designed by: NirMaryadi Rashid

Transforming Higher Education
for a Sustainable Tomorrow