BACHELOR OF ENGINEERING (NUCLEAR)

PROGRAMME SPECIFICATIONS

The Bachelor of Engineering (Nuclear) is offered on a full-time basis. The programme is offered only at the UTM Main Campus in Johor Bahru. The duration of study for the full-time programme is subjected to the student's entry qualifications and lasts between four (4) years to a maximum of six (6) years.

The programme is offered on full-time basis and is based on a 2-Semester per academic session. Generally, students are expected to undertake courses equivalent to between fifteen (15) to eighteen (18) credit hours per semester. Assessment is based on courseworks and final examinations given throughout the semester.

General Information

1. Awarding Institution			Universiti Teknologi Malaysia	
2. Teaching Institution			Universiti Teknologi Malaysia	
3. Programme Name			Bachelor of Engineering (Nuclear)	
4. Final Award			Bachelor of Engineering (Nuclear) with Honours	
5. Programme Code			TK21	
6. Professional or Statutory Body of Accreditation			Board of Engineers Malaysia (BEM)	
7. Language(s) of Instruction			English and Bahasa Malaysia	
8. Mode of Study			Conventional	
9. Mode of operation			Self-govern	
10. Study Scheme			Full Time	
11. Study Duration			Minimum : 4 years Maximum : 6 years	
Type of Semester	No. of Semesters		No of Weeks/Semester	
	Full Time	Part Time	Full Time	Part Time
Normal	8	-	14	-
Short	4	-	8	-

Course Classification

No.	Classification	Credit Hours	Percentage
i.	University Courses (a) General (b) Language (c) Entrepreneurship (d) Co-Curriculum	 10 8 2 3	16.6%
ii.	Faculty/ Programme Core	110	79.1%
iii.	Programme Electives	6	4.3%
	Total	**139**	**100%**
A	Engineering Courses (a) Lecture (b) Laboratory/ Workshop (c) Industrial Training (d) Final Year Project (e) Integrated Design Project	 74 6 5 6 4	68.3%
	Total Credit Hours for Part A	**95**	
B	Related Courses (a) Applied Science/ Mathematics/ Computer (b) Management/ Law/ Humanities/ Ethics/ Economy (c) Language (d) Co-Curriculum	 18 12 8 3	31.7%
	Total Credit Hours for Part B	**44**	
	Total Credit Hours for Part A and B	**139**	**100%**
	Total Credit Hours to Graduate	**139 credit hours**	

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

After having exposed to 3 to 5 years working experience, our graduates should become professionals who demonstrate the following competencies:

Code	Intended Educational Objectives
PEO1	Perform competently in chemical/ petroleum/ bioprocess/ gas/ nuclear Industries and become important contributors to national development.
PEO2	Become creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
PEO3	Contribute professionally towards the environmental well-being and sustainable development

PROGRAMME LEARNING OUTCOMES (PLO)

After having completed the programme, graduates should be able to demonstrate the following competencies

Code	Intended Learning Outcomes
PLO1 (KW)	Ability to apply knowledge of mathematics, natural science, engineering fundamentals, chemical/petroleum/bioprocess/ gas/nuclear engineering principles to the solution of complex engineering problems.
PLO2 (THPA)	Ability to identify, formulate, conduct research literature, and analyze complex chemical/ petroleum/ bioprocess/ gas/ nuclear engineering problems using first principles of mathematics and engineering sciences.
PLO3 (THDS)	Ability to design solution for complex chemical/ petroleum/ bioprocess/gas/nuclear engineering problems and design system or process to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PLO4 (THI)	Ability to conduct investigation of complex chemical/ petroleum/ bioprocess/ gas/ nuclear engineering 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.

PLO5 (SCMT)	Ability to inculcate modern computational techniques and tools complex chemical/ petroleum/ bioprocess/ gas/ nuclear which include prediction and modeling to solve complex engineering problem with an understanding of the limitations.
PLO6 (AD)	Ability to responsibly act as well as respond to the societal health, safety, environment, legal and cultural issues that are relevant to the professional engineering practice.
PLO7 (GCS)	Ability to explain and evaluate the sustainability and impact of professional engineering work in the solution of complex chemical/ petroleum/ bioprocess/ gas/ nuclear engineering problems in societal and environmental contexts.
PLO8 (GCE)	Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PLO9 (CS)	Ability to communicate effectively through written and oral modes to all levels of society
PLO10 (TW)	Ability to work independently, and as a member or a leader in a team to manage project in multi-disciplinary environment.
PLO11 (SC)	Ability to acquire knowledge and engage in independent and life-long learning.
PLO12 (ES)	Ability demonstrate knowledge of engineering management principles and entrepreneurial mindset to manage projects in multi-disciplinary environments.

Note: KW = Engineering Knowledge; THPA = Thinking Skills-Problem Analysis; THDS= Thinking Sills Design/Development of Solution; THI =Thinking Skills-Investigation; SCMT= Scholarship Modern Tool Usage; AD = Global Citizen Adaptability; GCS = Global Citizen Sustainability; GCE = Global Citizen Ethics; CS = Communicating Skills; TW = Leadership and Team Working; SC = Life Long Learning; ES = Enterprising Skills.

Award Requirements

To graduate, students must:

- Attain a total of not less than 139 credit hours with a minimum CGPA of 2.00.
- Pass Industrial Training.
- Complete all Professional Skill Courses.
- Sit for Test of English Communication Skills (TECS) for Graduating Students

Entry Requirements

The minimum qualifications for candidates who intend to do a Bachelor of Engineering (Nuclear) are as follows:

1) Minimum results based on **the Malaysian High School Certificate (STPM)** (results would be based on the general requirements as well as other conditions as the pre-requisites for the programme set by the university).

University General Requirements:

i. Passed and obtained good results in the Malaysian Certificate Examination (SPM) or its equivalent.
ii. Passed Bahasa Melayu/Bahasa Malaysia with credit in the SPM/ equivalent.
iii. Passed the Malaysian High School Certificate (STPM) or its equivalent and obtained the following:

a) Grade C (NGMP 2.00) General paper, and
b) Grade C (NGMP 2.00) in two other subjects

iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2.

Special Requirements for the Programme

i. Obtained a CGPA of 2.80; and Passed with a minimum Grade B- (NGMP 2.67) in two of the following subjects:

a) Mathematics T / Further Mathematics
b) Physics/ Chemistry/ Biology

ii. Passed with a minimum Grade B at SPM/equivalent examination in the following subjects:

a) Mathematics
b) Physics

iii. Candidate who fulfill the requirements in Physics or Biology at STPM must obtained a minimum Grade B at SPM level in Chemistry.
iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2.
v. Does not possess severe colour blindness or not physically handicapped that can constrain practical work.

2) Minimum requirements for **Matriculation Certificates (KPM) / Asasi Sains UM/Asasi UiTM** (fulfil the general requirements set by the university as well as other conditions of the programme).

General University Requirements

i. Passed the Malaysian Certificate Examination (SPM) with good results.
ii. Passed in Bahasa Melayu/Bahasa Malaysia with credits in the SPM/equivalent examination.
iii. Passed the Matriculation Certificate Examination (KPM) / Asasi Sains UM/ Asasi UiTM with a minimum CGPA of 2.00 and passed all the core subjects.
iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2.

Special Requirements of the Programme:

i. Obtained a CGPA of 2.80; and Passed with a Grade B- (2.67) in two of the following subjects:

a) Mathematics
b) Chemistry/Engineering Chemistry/Physics/Engineering Physics/ Biology

ii. Passed with a minimum Grade B at SPM/equivalent examination in the following subjects:

a) Mathematics
b) Physics

iii. Candidate who fulfill the requirements in Physics or Biology at STPM must obtained a minimum Grade B at SPM level in Chemistry.
iv. Passed the Malaysian University English Test (MUET) with minimum result of Band 2

v. Does not possess severe colour blindness or not physically handicapped that can constrain practical work.

3. Minimum qualifications for students with **Certificates/Diplomas**

There is no acceptance to the programme based on this qualification.

PROFESSIONAL SKILLS CERTIFICATE (PSC)

Students are given a chance to enroll in certificate programmes offered by the Centres of Excellence in the University and the School of Professional and Continuing Education (SPACE) during semester breaks

1. How to Get Yourself Employed (HTGYE)
2. ISO 9001: 2008 Quality Management System Requirement (ISO)
3. Occupational Safety and Health Awareness (OSHA)
4. How to Manage Your Personal Finance (HTMYPF)
5. Test of English Communication Skills for Graduating Students (TECS):
   (i) TECS 1001 (Paper I – Oral Interaction)
   (ii) TECS 1002 (Paper II - Writing)

CROSS-CAMPUS PROGRAMME

Students are given the opportunity to enrol in a few courses in participating universities. The grades and credits obtained during this period are transferable (up to 1/3 of the total credits of the curriculum). Currently, there are four participating universities i.e. Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Malaya and Universiti Malaysia Sarawak.

The programme is open to undergraduates who have undergone a minimum of two semesters of their studies with the following conditions:

(i) The total number of credits allowed to be taken is between twelve (12) and sixteen (16) credits only.
(ii) The student should hold a minimum CGPA of 3.00 at the time of application.
(iii) The student is not a residence of or originated from the state where the university that he/she intends to attend is located.

The student will not be charged tuition fees by the participating university but shall pay the regular tuition fees at UTM. However should the participating university provide accommodation, the student will need to pay accommodation fees.

COURSE MENU

YEAR 1: SEMESTER 1			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 1113	Modern Physics	3	
SKTN 1143	Introduction to Engineering	3	
SKTN 1243	Statics	3	
SSCE 1693	Engineering Mathematics I	3	
UHAS 1172	Dinamika Malaysia (for Local Students)	2	
UHAK 1022	Malaysian Studies 3 (for International Students)		
ULAB 1122	Academic English Skills	2	
	TOTAL CREDIT	**16**	
	CUMULATIVE CREDITS	**16**	

YEAR 1: SEMESTER 2			
Code	**Course**	**Credit**	**Pre-requisite**
SCSJ 2273	Programming for Engineers	3	
SKTN 1123	Fluid Mechanics	3	
SKTN 1224	Electrical Eng. Fundamentals with Laboratory	4	
SKTN 2213	Nuclear Physics	3	SKTN 1113
SSCE 1993	Engineering Mathematics II	3	SSCE 1693
UICI 1012	Islamic and Asia Civilization (for Local Students)	2	
ULAM 1012	Malay Language Communication 2 (for International Students)		
	TOTAL CREDIT	**18**	
	CUMULATIVE CREDITS	**34**	

YEAR 2: SEMESTER 1			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 1133	Engineering Drawing	3	
SKTN 1711	Fluid Mechanics Lab	1	SKTN 1123
SKTN 2113	Thermodynamics	3	
SKTN 2123	Strength of Materials	3	
SKTN 2243	Nuclear Engineering Fundamentals	3	
SSCE 1793	Differential Equations	3	SSCE 1993
ULAB 2122	Advanced Academic English Skills	2	
	TOTAL CREDIT	**18**	
	CUMULATIVE CREDITS	**52**	

YEAR 2: SEMESTER 2			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 2133	Dynamics	3	SKTN 1243
SKTN 2223	Heat Transfer	3	SKTN 2113
SKTN 2393	Numerical Methods for Nuclear Engineers	3	SSCE 1793
SKTN 2711	Thermodynamics & Mechanics of Material Laboratory	1	SKTN 2113 SKTN 2123
SSCE 2193	Engineering Statistics	3	
UHAK 1012	Graduate Success Attributes	2	
UKQ* 2**2	Co-curriculum Service Learning	2	
	TOTAL CREDIT	**17**	
	CUMULATIVE CREDITS	**69**	

YEAR 3: SEMESTER 1			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 3113	Nuclear Radiation Protection	3	
SKTN 3213	Nuclear Reactor Theory	3	
SKTN 3233	Radiation Detection and Measurement	3	
SKTN 3711	Nuclear Physics Lab	1	SKTN 2213
SKTN 4453	Nuclear Power Plant System	3	
UICL 2302	The Thought of Science and Technology	2	
ULAB 3162	English for Professional Purpose	2	
UKQ 3001	Extracurricular Experiential Learning (ExCEL)	1	
	TOTAL CREDIT	**18**	
	CUMULATIVE CREDITS	**87**	

YEAR 3: SEMESTER 2			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 3123	Nuclear Reactor Material	3	SKTN 2123
SKTN 3223	Instrumentation and Control Engineering	3	
SKTN 3224	Thermal Hydraulics with Lab	4	SKTN 2223 SKTN 1123
SKTN 3721	Nuclear Reactor Lab	1	SKTN 3213
SKTN 4812	Undergraduate Project I	2	
UHAK 2**2	Soft Skills Elective	2	
ULA* 1112	Foreign Language Elective	2	
	TOTAL CREDIT	17	
	CUMULATIVE CREDITS	104	

YEAR 3: SEMESTER 3			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 3915	Industrial Training	5	
	TOTAL CREDIT	**5**	
	CUMULATIVE CREDITS	**109**	

YEAR 4: SEMESTER 1			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 3173	Engineering Economics & Project Management	3	
SKTN 3253	Nuclear Safety, Safeguard, Security & Regulation	3	
SKTN 4113	Nuclear Fuel Cycle and Waste Management	3	
SKTN 4711	Radiation, Detection & Measurement Lab	1	SKTN 3233
SKTN 4824	Undergraduate Project II	4	SKTN 4812
SKTN 4833	Nuclear Engineering System and Design I	3	SKTN 4453
	TOTAL CREDIT	**17**	
	CUMULATIVE CREDITS	**126**	

YEAR 4: SEMESTER 2			
Code	**Course**	**Credit**	**Pre-requisite**
SKTN 4611	Nuclear Engineering Professional Practice	1	
SKTN 4834	Nuclear Engineering System and Design II	4	SKTN 4833
SKTN 4**3	Elective Nuclear I	3	
SKTN 4**3	Elective Nuclear II	3	
UHAK 1032	Introduction to Entrepreneurship	2	
	TOTAL CREDIT	**13**	
	CUMULATIVE CREDITS	**139**	

Elective Courses

- SKTN 4413 Sustainable Energy
- SKTN 4423 Ultrasonic Testing
- SKTN 4433 Chemistry in Nuclear Engineering
- SKTN 4443 Risk Assessment
- SKTN 4483 Radiographic Testing

GRADUATION CHECKLIST

To graduate, students must pass all the stated courses in this checklist. It is the responsibility of the students to ensure that all courses are taken and passed. Students who do not complete any of the course are not allowed to graduate.

NO.	CODE	COURSE	CREDIT EARNED (JKD)	CREDIT COUNTED (JKK)	TICK (√) IF PASSED
NUCLEAR ENGINEERING COURSES					
1	SCSJ 2273	Programming for Engineer	3	3	
2	SKTN 1113	Modern Physics	3	3	
3	SKTN 1123	Fluid Mechanics	3	3	
4	SKTN 1133	Engineering Drawing	3	3	
5	SKTN 1143	Introduction to Engineering	3	3	
6	SKTN 1224	Electrical Eng. Fundamental with Lab	4	4	
7	SKTN 1243	Statics	3	3	
8	SKTN 1711	Fluid Mechanics Lab	1	1	
9	SKTN 2113	Thermodynamics	3	3	
10	SKTN 2123	Strength of Materials	3	3	
11	SKTN 2133	Dynamics	3	3	
12	SKTN 2213	Nuclear Physics	3	3	
13	SKTN 2223	Heat Transfer	3	3	

14	SKTN 2243	Nuclear Engineering Fundamentals	3	3	
15	SKTN 2393	Numerical Methods for Nuclear Engineers	3	3	
16	SKTN 2711	Thermodynamics & Mechanics of Material Lab	1	1	
17	SKTN 3113	Nuclear Radiation Protection	3	3	
18	SKTN 3123	Nuclear Reactor Materials	3	3	
19	SKTN 3173	Engineering Economics & Project Management	3	3	
20	SKTN 3213	Nuclear Reactor Theory	3	3	
21	SKTN 3223	Instrumentation and Control Eng.	3	3	
22	SKTN 3224	Thermal Hydraulics with Lab	4	4	
23	SKTN 3233	Radiation Detection and Measurement	3	3	
24	SKTN 3253	Nuclear Safety, Safeguard, Security & Regulation	3	3	
25	SKTN 3711	Nuclear Physics Lab	1	1	
26	SKTN 3721	Nuclear Reactor Lab	1	1	
27	SKTN 3915	Industrial Training	5	HL	
28	SKTN 4113	Nuclear Fuel Cycle & Waste Management	3	3	
29	SKTN 4453	Nuclear Power Plant System	3	3	
30	SKTN 4611	Nuclear Eng. Professional Practice	1	1	
31	SKTN 4711	Rad. Detection & Measurement Lab	1	1	
32	SKTN 4812	Undergraduate Project I	2	2	
33	SKTN 4824	Undergraduate Project II	4	3	
34	SKTN 4833	Nuclear Eng. System & Design I	3	3	
35	SKTN 4834	Nuclear Eng. System and Design II	4	4	
36	SKTN 4**3	Elective 1	3	3	
37	SKTN 4**3	Elective 2	3	3	
		TOTAL CREDIT OF NUCLEAR ENGINEERING COURSES (a)	**104**	**99**	
MATHEMATICS COURSES (Faculty of Science)					
1	SSCE 1693	Engineering Mathematics I	3	3	
2	SSCE 1793	Differential Equations	3	3	
3	SSCE 1993	Engineering Mathematics II	3	3	
4	SSCE 2193	Engineering Statistics	3	3	
		TOTAL CREDIT OF MATHEMATICS COURSES (b)	**12**	**12**	
UNIVERSITY GENERAL COURSES					
Cluster 1: Appreciation of Philosophy, Value & History (Faculty of Social Sciences and Humanities)					
1	UHAS 1172	Dinamika Malaysia (for Local Students)	2	2	
	UHAK 1022	Malaysian Studies 3 (for International Students)			
2	UICI 1012	Islamic and Asia Civilization (for Local Students)	2	2	
	ULAM 1012	Malay Language Communication 2			

		(for International Students)			
Cluster 2: Generic Skills					
1	UHAK 1012	Graduate Success Attributes	2	2	
2	UHAK 2**2	Soft Skills Elective	2	2	
Cluster 3: Expansion of Knowledge					
1	UICL 2302	The Thought of Science and Technology	2	2	
Cluster 4: Co-Curriculum and Service Learning					
1	UKQ* 2**2	Co-Curriculum & Service Learning	2	2	
2	UKQ 3001	Extracurricular Experiential Learning (ExCEL)	1	1	
Cluster 5: Language Skill (Language Academy, Faculty of Social Sciences and Humanities)					
1	ULAB 1122	Academic English Skills	2	2	
2	ULAB 2122	Advanced Academic English Skills	2	2	
3	ULAB 3162	English for Professional Purpose	2	2	
4	ULA* 1112	Foreign Language Elective	2	2	
Cluster 6: Entrepreneurship					
1	UHAK 1032	Introduction to Entrepreneurship	2	2	
		TOTAL CREDIT of UNIVERSITY GENERAL COURSES (c)	**23**	**23**	
		TOTAL CREDIT TO GRADUATE (a + b + c)	**139**	**134**	
OTHER COMPULSORY COURSES					
Professional Skills Certificate (PSC) (UTMSPACE/ School)					
1	GLL 1001	How to Get Your Self Employed			
2	GLL 1029	ISO 9001:2008 Quality Management System Requirement			
3	GLL 1040	Occupational Safety, Health and Environment			
4	GLL 1041	How to Manage Your Personal Finance			
Test of English Communication Skill (TECS) (Language Academy, Faculty of Social Sciences and Humanities)					
1	TECS 1001	Oral Interaction			
2	TECS 1002	Writing			

COURSE SYNOPSIS

CORE COURSES

SCSJ 2273 Programming for Engineers

This course formally introduces the concept of computers, algorithms, programming languages, pseudocode, and problem solving. The two programming languages introduced in this course are Fortran and MATLAB. Topics covered in this course include data types, constants, variables, arithmetic operations, assignment statement, looping, formatted I/O, functions, arrays, matrix operations, data structures, plotting, and model building.

SKTN 1113 Modern Physics

The course begins with a brief discussion on the nature of science in the quest of better understandings of the natural phenomena the inadequacy and failures of classical physics. It is then followed by introductory lesson on Special Relativity Theory and relevant consequences of this theory. A modern quantum mechanics interpretation on blackbody radiation, photoelectric and Compton effect will also be discussed. It will then proceed to the lesson on atomic models and quantum numbers. Finally, formalities of quantum mechanics are introduced by discussing the 1-D time independent Schrodinger equation (TISE), applied to an idealized infinite square potential well.

SKTN 1123 Fluid Mechanics

This course introduces students to physics of fluid: what is fluid, some definitions, surface tension, compressible and Incompressible flow, classes of flow, and physical classification. Fluid statics: pressure, differential equations of fluid statics, manometry, fluid force on submerge bodies, buoyancy and stability of floating bodies, and liquid in relative equilibrium. Fluid in motion: continuity equation, energy and mass equilibrium, Euler, Bernoulli and Momentum equations. Friction in fluid flow: velocity profile in pipes, roughness, friction factor, Moody chart. Flow measurement: venturi and pitot tube, orifice, notches and weirs. Pump and pumping: principle, types, selection, and application of pumps. Dimensional analysis, similitude in fluid mechanics, parameters of incompressible and compressible flow. Besides lectures, the course has tutorial classes.

SKTN 1133 Engineering Drawing

This course provides a fundamental background in engineering drawing to the students, which will enable them to work more effectively in the various fields of engineering. This course aims at developing the skills needed for documenting designs using drawings and for performing graphical analysis of two dimensional and three-dimensional problems. The students will be exposed to different available CAD for engineering drawing with more emphasis on the utilization of QCAD and AutoCAD software. This course

focuses on the introduction to engineering drawing, fundamentals of engineering drawing, geometry, orthographic and isometric drawing. This course also introduces the sectional and flowchart drawing and computer aided engineering drawing to the students. Besides that, this course also provides the basic skills and concept on the technical drawing of the gas engineering related Piping & Instrumentation Diagram (P&ID) that is essential for process industries.

SKTN 1143 Introduction to Engineering
The objective of this course is to introduce and prepare students for learning engineering and how to become engineers of the future. This course serves to bridge pre-university education to university life and provide support for adjusting to learning and expectations in tertiary education. This course introduces the students to the engineering profession, how to prepare for an exciting engineering career, the design process, engineering communication, thinking skills and ethics. The students will also be introduced with systematic approaches to deal with basic engineering problems. Special emphasis will be on enhancing students' communication skills. Problem-Based Learning (PBL) case study on sustainable development will be implemented for a mini project consists of three stages.

SKTN 1224 Electrical Engineering Fundamentals with Lab
This course introduces students to the fundamentals of electrical and electronic engineering through lecture and laboratory sessions. It covers components (passive, active, semiconductor-based), circuits (AC, DC, analogue, digital) and the methods for analyzing circuitry. The laboratory sessions reinforce students' understanding of the theory and electronic expose them to electronics test and measurement equipment. At the completion of this course students are expected to be able to understand electrical and electronic engineering, draw and analyze electronic circuits, use test and measurement instruments, and design basic analogue and digital electronic circuits using active and passive components.

SKTN 1243 Statics
This course is designed to introduce students to the basic principles and concepts in mechanics. It deals with the resultant and resolution of force(s) acting on a particle, the equilibrium of a particle, the effect of force(s) on rigid bodies, how to replace a force system with equivalent system and the equilibrium of rigid bodies. This course also includes the determination of centroid, analysis of structure and friction. At the end of the course, students should be able to demonstrate and apply the knowledge by solving various problems in Statics, which forms the basis of further engineering subjects especially Mechanics of Materials and Fluid Mechanics. Besides lectures, the course has tutorial classes.

SKTN 1711 Fluid Mechanics Lab
Pre-requisite: SKTN 1123 Fluid Mechanics (taken)
This laboratory course contains 7 experiments that cover basic concepts in Fluid Mechanics. Laboratory experiments are designed for hands-on experience to understand the engineering principles. The experiment includes Flow Measurement, Bernoulli's Principles, Stability of Floating Body, Jet Impact, Forced Vortex Flow, Minor and Major Losses in Pipes. This course also emphasizes the technical writing aspect where all students' observation and arguments of each experiment must be reported in proper format.

SKTN 2113 Thermodynamics
Thermodynamics is a fundamental engineering subject where thermodynamic system, boundaries, mass, heat, work, internal energy and enthalpy are explained. Properties of common fluid, such as water, air, and refrigerants are determined either using tables of properties or equations. These are then related to the concepts of 1st Law of Thermodynamics for energy balance calculation and analysis. To further analyze whether a process is possible or not requires a knowledge of 2nd Law of Thermodynamics where another thermodynamic property known as entropy is introduced. All these concepts are then applied to a more integrated and complex power and refrigeration cycle systems. Besides lectures, the course has tutorial classes.

SKTN 2123 Strength of Materials
The first part of this course is introductory to Materials Engineering. Topics include classification of materials (metals, ceramics, polymers, composites and semiconductors); atomic bonds; crystal structure; crystalline defects and solid solutions; and phase diagrams. Main emphasis is on metals because metals are structurally the simplest to characterize and a sound knowledge of structure-property relation of metals can be extended to the study of ceramics and polymers. The second part of the course deals with Mechanics of Materials. Topics cover stress and deformation of members under axial loading, torsion in circular shafts, analysis and design of beams for bending, and stress transformation. Throughout the course, strong emphasis is placed on drawing a free-body diagram, selecting appropriate coordinate system,using the correct sign convention.

SKTN 2133 Dynamics
Pre-requisite: SKTN 1243 Statics (taken)
This course is designed to introduce students to the second part of mechanics which deals with the analysis of particles and bodies in motion. It will include the kinematics and kinetics of particles. It will cover the rectilinear and curvilinear motion of particles, Newton second law of particles, and work and energy for particles. At the end of the course, students should be able to demonstrate and apply the knowledge by solving various problems involving kinematics and kinetics of particles and kinematics of rigid bodies, which forms the basis of further engineering subjects. Besides lectures, the course has tutorial classes.

SKTN 2213 Nuclear Physics
Pre-requisite: SKTN 1113 Modern Physics (pass with at least D+)
The course introduces to some major concepts and theories of nuclear physics. The course begins with understanding the basic knowledge of the constituents of nucleus and the properties of nuclear forces. Nuclear models such as liquid drop model, shell model and optical model of the nucleus will be introduced afterward. The next topic of the course is introducing the radiation sources and the types of ionizing radiations. Nuclear decay process and the properties of ionizing radiations will be discussed in this topic. The interactions of nuclear radiations with matter and mechanism of nuclear reaction are also covered in this subject. The next topic is providing the students with some basic concept on radioactivity including radioactive decay law, radioactive decay series and radioactive equilibriums. In general, the course provides a basic concept of interaction processes of nuclear radiation in order to widening the appreciation of nuclear physics to the students.

SKTN 2223 Heat Transfer
Pre-requisite: SKTN 2113 Thermodynamics (pass with at least D+)
In this course, three basic modes of heat transfer, namely conduction, convection and radiation, will be covered. Emphasis will be on developing a physical and analytical understanding of the three modes of heat transfer, as well as its applications. Students will develop an ability to apply governing principles and physical intuition to solve single and multi-mode heat transfer problems for one or two-dimensional system of either steady or transient state. This course also introduces methods for calculating rates of heat transfer by these three modes. The concepts of thermal resistance network will be developed for the analysis of heat flows.

SKTN 2243 Nuclear Engineering Fundamentals
This course introduces students to the fundamentals of nuclear engineering. The course provides a broad overview of the fundamental aspects of nuclear engineering and an introductory comparative analysis of nuclear power and other energy sources. The course also provides comparative analysis between different types of nuclear reactors. Other topics covered include theory and thermal hydraulics of nuclear reactors, nuclear power generations, nuclear fuel cycle and control, Radiation and radiation control and nuclear safety.

SKTN 2393 Numerical Methods for Nuclear Engineers
This course formally introduces the steps involved in engineering analysis (mathematical modeling, solving the governing equation, and interpretation of the results). Example of case studies in applied mechanics, strength of materials, thermal science, and fluid mechanics are presented. Methods for solving the nonlinear equations, simultaneous linear algebraic equations, eigenvalue problem, interpolation, numerical differentiation, numerical integration, initial value problems, boundary value problem and Monte Carlo method are introduced.

SKTN 2711 Thermodynamics & Mechanics of Material Lab
Pre-requisites: SKTN 2113 Thermodynamics (taken)
SKTN 2123 Strength of Materials (taken)
This laboratory course contains 6 experiments that covered basic concepts in Thermodynamics and Strength of Material. Laboratory experiments are designed for hand-on experience to understand the engineering principles. The experiments application includes First Law of Thermodynamics, Second Law of Thermodynamics, Properties of Pure Substance and Properties and Strength of Materials. This course also emphasizes the technical writing aspect where all students' observation and arguments of each experiment must be reported in proper format.

SKTN 3113 Nuclear Radiation Protection
This course is designed to ground students in the principles of radiation protection, that is, on justification, optimization and dose limits. It will emphasize on the theories, the techniques and the procedures for external dose control that is the use of distance, shielding and time; and internal dose control, including introduction to the physics of aerosol, use of unsealed sources, primary and secondary containments, radioactive laboratories and leak tests. The course will also discuss organization and radiation protection programmes; emergency procedures, monitoring, radiological protection in radiation devices, transport regulations and radioactive waste management. Upon completion, students should have an overall grasp of the radiation protection principles and practice; and most importantly the safety culture required.

SKTN 3123 Nuclear Reactor Materials
Pre-requisite: SKTN 2123 Strength of Materials (taken)
This course will provide a valuable insight on some of the key issues facing the nuclear power generation industry. Many of these are related to the materials involved, their response to, and their reliability under extreme conditions. The effects of radiation on various properties of materials in nuclear applications will be dealt with to get an appreciation of the materials' limitations on the operation of reactors. Students will first be introduced to the basic concepts of materials science. The basic aspects of the nuclear fuel cycle, current and future nuclear reactor designs, and the materials problems associated with nuclear energy production will be discussed. The key issues in materials failures and the requirements for efficient and safe operation of current reactor designs as well as design of novel materials for future reactors will be discussed. A few applications of radiation effects will then be treated with this newfound framework, including the change of material properties under irradiation, void swelling, embrittlement and loss of ductility. At the end of this course, students will be familiar with the basic issues concerning the selection of materials for various components in nuclear reactors.

SKTN 3173 Engineering Economics & Project Management
This is a two-in-one course covering both Engineering Economy and Project Management topics. Engineering economy is the application of economic factors and criteria to evaluate alternatives, considering the time value of money. The engineering economy study involves computing a specific economic measure of worth for estimated cash flows over a specific period of time. Project Management is the art of planning, scheduling, and monitoring of project activities to achieve performance, cost, and time objectives, for a given scope of works, while using resources efficiently and effectively.

SKTN 3213 Nuclear Reactor Theory
The course starts with discussion on neutron physics related to production, absorption and scattering of neutron, neutron cross sections and nuclear fission. The next topics will emphasize on the principle of neutron moderation and neutron multiplication leading to steady state fission reactor core design based on diffusion theory. The next topic will emphasize on the reactor equation solutions of neutron flux, maximum to average flux and power for rectangular, cylindrical and spherical reactor. In general, the course provides on the general concepts of neutron physics and it application in nuclear reactor for energy generation. The course will solve the point reactor dynamic equation and apply safety characteristics using point kinetics models.

SKTN 3223 Instrumentation and Control Engineering
This course introduces students to the concept of electrical measurement using analogue and digital instruments, methods for mathematical model building of physical systems and processes, control systems and the use of software in analyzing system and controller performance. Transducers that are used in instruments for measuring common parameters such as temperature and pressure are presented. Instrumentations used in nuclear facilities such as nuclear reactors are covered. This course will also show students the methods to obtain mathematical model of actual physical system such as electrical, mechanical, thermal, and nuclear systems. Further the fundamental ideas and structures of control system such as open loop and feedback controls, transfer functions, block diagrams, and controller responses will be covered. The use of transfer functions for controller construction and analysis of controller performance in time domain using MATLAB and Simulink will also be introduced.

SKTN 3224 Thermal Hydraulics with Lab
Pre-requisite: SKTN 1123 Fluid Mechanics (taken)
SKTN 2223 Heat Transfer (taken)
This course covers the thermo-fluid dynamic phenomena and analysis methods for conventional and nuclear power stations. Fundamental processes of heat generation and transport in nuclear reactors. Effects of boiling and critical heat flux. Fundamentals of reactor thermal and hydraulic design. Specific topics include: kinematics and dynamics of two-phase flows, boiling, and critical conditions, single channel transient analysis, loop analysis

including single and two phase natural circulation, and sub-channel analysis. Students will also perform laboratory experiments to reinforce understanding of thermal hydraulic phenomena.

SKTN 3233 Radiation Detection and Measurement
The important detection techniques for radiations are introduced in this course. The discussion begins with introducing the principles of radiation detection related to radiation units, radiation sources and radiation interactions. Nuclear radiation detector parameters such as detector model, detector efficiency, energy resolution, counting curve and counting statistics are discussed. The next topic will emphasize on the principles of operation and basic characteristics of various detection systems. Various nuclear detectors such as gas filled detector, scintillation detector and semiconductor detector are main concerned of the subject. The course also emphasizes on the principle and operation of thermal and fast neutron detector. The principle of radiation dosimetry such as thermolumeniscent dosimetry, chemical dosimetry, film dosimetry and calorimeter are also discussed at the end of the course.

SKTN 3253 Nuclear Safety, Safeguard, Security & Regulation
This course introduces students to safety, safeguards, security and regulations pertaining to nuclear activities. The focus of the course is on administrative and technical approaches to enhance nuclear safety, national and international safeguard regimes, and security measures to ensure safe use of nuclear technologies. National and international legal instruments and agencies will be introduced. Engineered and inherent safety features, reliability enhancement through redundancy, methods of safety and risk analysis such as probabilistic safety analysis, fault tree and event trees, FMEA will be covered. Students are expected to develop understanding on the importance of nuclear safety, security, safeguards and the legal instruments that are in place to ensure conformance to peaceful uses of nuclear technology.

SKTN 3711 Nuclear Physics Lab
Pre-requisite: SKTN 2213 Nuclear Physics (taken)
The course covers eight nuclear physics-related experiments. Experiments of health physics and radiation safety are performed and laboratory reports are written by students. Experiments are performed at UTM. Topics of experiment include: 1. Geiger Muller Tube detector, 2. Resolving time 3. Counting statistics, 4. Linear absorption coefficient and inverse square law, 5. Attenuation of betas in aluminium, 6. Limitation of dose system, 7. Absolute efficiency of Geiger Muller.

SKTN 3721 Nuclear Reactor Lab
Pre-requisite: SKTN 3213 Nuclear Reactor Theory (taken)
A series of nuclear reactor related experiments are performed in Malaysia Nuclear Agency (MNA) research facilities. The students will be given hands-on

experience in dealing with nuclear reactor system and instrumentation. Student will carry out experiments on site and are required to prepare technical reports for each experiment.

SKTN 3915 Industrial Training
This course is a core course which will assign students to industries, governments or semi-governments agencies and organizations for a period of 12 weeks. The training aims to expose students to real nuclear engineering practices while enhancing their knowledge and working experiences as well as improving their interpersonal skills. The students also have the opportunities to apply learned theories into real nuclear engineering practices. Students will be supervised by the faculty and industrial supervisors.

SKTN 4113 Nuclear Fuel Cycle and Waste Management
This course consists of two parts: Nuclear Fuel Cycle and Waste Management. The first part introduces students to the front-end of the fuel cycle: ore extraction, conversion and enrichment, fuel fabrication and use in the power plant, spent fuel reprocessing. In the second part, the back-end of the fuel cycle will be discussed. It is including the radioactive waste management, ranging from waste characteristics, waste treatment technologies, radioactive materials transportation and decontamination and decommissioning related to radioactive e processes and materials. At the successful completion of this course the students will be able to describe the following features of a Nuclear Fuel Cycle and Waste Management: Nuclear fuel resources, Uranium enrichment, Nuclear fuel fabrication, Spent fuel storage, Nuclear fuel reprocessing, Waste disposal, Radioactive materials transportation, and Decontamination and decommissioning.

SKTN 4453 Nuclear Power Plant System
The degree program in Nuclear Power Plant System Engineering comprises a wide range of power engineering titles aimed at theoretical and practical exposure. This program has been developed to train highly qualified professionals to design, operate and maintain power plants. Students are required to describe sources of energy and types of power plants. The analysis of different types of steam cycles and estimation of the efficiencies in a steam power plant will be carried out. The basic working principles of gas turbine and diesel engine power plants are also described in terms of the performance characteristics and components of such power plants. Evaluation on cycle efficiency and performance of a gas cooled reactor power plant are included in this course by listing the different types of fuels used in power plants and estimating their heating values. Further, the calculation on the present worth depreciation, cost of different types of power plants and estimation on the cost of producing power per kW will be done.

SKTN 4611 Nuclear Engineering Professional Practice
This course emphasizes the nuclear engineering ethics and engineer's responsibilities towards safety, health and welfare of the public from

professional point of view. Few speakers from nuclear-related areas such as from Agensi Nuklear Malaysia (ANM), Malaysian Nuclear Power Corporation (MNPC), and Atomic Energy Licencing Board (AELB) will be invited to give talks to the students. The talks will place emphasis on the engineer as a professional man, engineers in society, code of ethics and professional conducts, standards, laws and regulations pertaining to professional engineering practice. At the end of this course, students will acquire the concept of professionalism and ethical responsibility and be able to demonstrate and apply engineering professional ethics in their career as an engineer.

SKTN 4711 Radiation, Detection & Measurement Lab
Pre-requisite: SKTN 3233 Radiation Detection and Measurement (taken)
The course covers seven nuclear experiments. Experiments of radiation detection and measurement are performed and laboratory reports are written by students. Topics of experiment include energy calibration of detector, resolution of detector, efficiency calibration of detector, gamma spectroscopy, radon measurement, alpha spectrometry, and liquid scintillation.

SKTN 4812 Undergraduate Project I
This course is designed to train students on the important aspects of research management. Student will be assigned to a nuclear engineering related topic and required to prepare a research proposal that will be implemented in the following semester. At the end of this course, students should be able to present their proposal. In addition, students will have opportunity to gain important generic skills such as communication, team working, problem-solving and creative and critical thinking.

SKTN 4824 Undergraduate Project II
Pre-requisite: SKTN 4812 Undergraduate Project I (pass with at least D+)
This course is a continuation of the Undergraduate Research Project I (SKTN 4812). The second part of Undergraduate Research Project requires students to implement the research proposal that has been prepared in the previous semester. This might involve practical activities such as laboratory works, data collection from industry and computer programming / simulation. At the end of this course, students should be able to prepare a full report compiling the first and second part of the Undergraduate Research Project and subsequently present their research findings. Finally, students must submit a working paper and a bound thesis according to the UTM thesis-writing format. In addition, students will have opportunity to gain important generic skills such as communication, problem-solving and creative and critical thinking.

SKTN 4833 Nuclear Engineering System and Design I
Pre-requisite: SKTN 4453 Nuclear Power Plant System (taken)
This course introduces students to nuclear engineering systems, particularly

nuclear reactors and their systems, subsystems, and major components. It also introduces students to systematic engineering design approach including needs definition, concept generation and selection, technical specifications, and design trade-offs. With respect to nuclear reactor design, the course focuses on core design, safety systems, fuel elements, and cooling systems. Students will be introduced to software packages for thermal hydraulics and core design, particularly MCNP code. Economics and financial aspect in the design of nuclear systems will also be introduced. This course is also aimed at preparing students with good knowledge and understanding of nuclear systems design.

SKTN 4834 Nuclear Engineering System and Design II
Pre-requisite: SKTN 4833 Nuclear Engineering System and Design I (taken)
This capstone course is a group design project, with nuclear industrial based case, involving integration of knowledge in nuclear physics, neutron transport, heat transfer, safety, materials, environmental impact and economic analysis. It provides opportunities to synthesize knowledge acquired in nuclear engineering and apply this knowledge to complex problems of current interest in nuclear power plant design. Students are required to present interim design project, final design presentation and submit the final design report.

ELECTIVE COURSES

SKTN 4413 Sustainable Energy
In the context of depleting fossil fuel reserves and environmental consequences, the concept of sustainable energy warrants to be a contemporary subject matter. This course explains the concepts of sustainable energy technology based on ethics, environments and economy (E^3) and the role of sustainability in practical system applications and innovation. The course recognizes the effects from the fossil dominated energy systems over economics, environment and the society. The course provides the latest review of the most important renewable energy resources, advanced technologies, and explains the sustainability basis for harnessing them. The course also demonstrates evaluating the energy technologies and systems to be economically feasible, environmentally bearable and socially acceptable. Comprehension of the issues associated with sustainable energy technology are achieved through lectures, discussions, combined with reports and student presentations on the literature reviewed.

SKTN 4423 Ultrasonic Testing
The course starts with the introduction of the underlying science of ultrasonic and acoustic wave propagation in elastic media, and its application to non-destructive evaluation. Students will be introduced to the mathematical equations that govern the propagation of ultrasonic and acoustic waves. The

student will be expose to different ultrasonic probes, their types and construction. This is followed calibration of the testing device and sensitivity adjustment. The theoretical material will be covered in a number of illustrated lectures, reinforced by worked example classes. In parallel with the theoretical aspect of the course, students will undertake a number of experimental tasks to demonstrate how the theory translates into practice. In general, these tasks will be drawn from examples from the field of non-destructive evaluation, using standard industrial procedure.

SKTN 4433 Chemistry in Nuclear Engineering

The subject focuses on the chemistry aspects of nuclear engineering. The physico-chemical properties in radioactivity and binding energy are presented in this course. The occurrence of radionuclide in nature as well as the stability and radioactivity of the radionuclides are evaluated. The chemical effects of radiation on the radiolysis of various organic and inorganic matters are also discussed. The production and separation methods of radionuclides and their chemical behaviors are also covered in this course. The applications of these radionuclides in qualitative and quantitative chemical analysis are included. This course also discusses the production of hydrogen gas as alternative fuel using nuclear energy. The final part of this course deals with the emerging application of nuclear reaction for transmutation of elements and isotopes.

SKTN 4443 Risk Assessment

Fundamental safety principles in nuclear industry require assessment of safety for all facilities and activities that potentially give rise to radiation risks. Safety assessment in particular is a systematic process that is carried out to ensure that all safety requirements are met. This course addresses the fundamental aspects of safety assessment providing the basis for specialized training in the area of deterministic and probabilistic safety assessments. This course also discusses safety assessment of main system design that include reactor core, coolant and containment system. It provides for introductory and preparatory knowledge necessary for engineers and regulatory personnel engaged in safety analysis performance.

SKTN 4483 Radiographic Testing

This course describes Non-Destructive Testing (NDT) which is the process of inspecting, testing or evaluating materials, components or assemblies for discontinuities without destroying their serviceability. The course introduces the six most common NDT methods which are Visual Testing, Liquid Penetrant Testing, Magnetic Particle Testing, Radiographic Testing, Ultrasonic Testing and Eddy Current Testing. Emphasis will be given to Radiographic Testing which is also known as Industrial Radiography. Metal forming and manufacturing processes and possible defects present in each process will be described. The most widely used industry inspection and acceptance standards for NDT such as ASME V, VIII and API 1104 will be described.