NANYANG TECHNOLOGICAL UNIVERSITY

Teaching, Learning and Pedagogy Division

Reg. No. 200604393R

PROPOSED COURSE OUTLINE TEMPLATE FOR STUDENTS AT NTU

Academic Year	2018-19	**Semester**	1
Course Coordinator	Assoc/Prof. Ali I Maswood		
Course Code	EE4532		
Course Title	**POWER ELECTRONICS AND DRIVES**		
Pre-requisites	Before AY2021-22 Sem2:	EE3010 Electrical Devices & Machines and EE3015 Power Systems & Conversion	
	AY2021-22 Sem2 and onwards:	EE3010 Electrical Devices & Machines and EE3015 Power Systems & Conversion or EE2005 Electrical Devices & Machines and EE3015 Power Systems & Conversion	
No of AUs	3		
Contact Hours	Lectures: 26 hours; Tutorials: 12 hours		
Proposal Date	5 March 2020 (REF#ACC-CN-2020/06_ITN-02)		

Course Aims

The objective of this course is to familiarize you with the utilization aspects of power engineering, more specifically the techniques of solid-state power conversions and their applications. To meet industry requirement for power electronic engineers, adequate practical knowledge on power semiconductors, converter topologies, control techniques and typical applications in motor drives and other applications are emphasized.

Intended Learning Outcomes (ILO)

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

1. Identify and differentiate switching devices in converters, e.g. diodes, thyristors, transistors etc.
2. Decipher the operational principles behind various power converters
3. Convert one form of power to another form of power such as AC-DC, DC-DC, DC-AC etc.
4. Identify distortions in AC/DC currents/voltages, and the means to mitigate them
5. Apply DC-DC converters to DC motor drives

Course Content

Introduction to Power Electronic Systems and Devices. Uncontrolled and Controlled Rectifiers. Quality of converted AC/DC Current/Voltage waveforms. Hard Switching Power Converters. Principles and Control of Motor drives.

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or	Weighting	Team/Individual	Assessment rubrics

		Graduate Attributes			
1. Examination	LO 1-4	EAB SLO a, b, c	60%	Individual	
2. Continuous Assessment	Quiz 1 LO 1-2 Quiz 2 LO 2-5	EAB SLO a, b, c	20% 20%	Individual	
Total			100%		

* EAB SLO stands for the Engineering Accreditation Board Student Learning Outcomes. The list is below:

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems

b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

e) **Modern Tool Usage:** 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.

f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.

h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j) **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.

k) **Project Management and Finance:** Demonstrate knowledge and understanding of the 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.

l) **Life-long Learning:** 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

Formative feedback

After each CA, it will be discussed in class and correct approach will be formulated. Similar possible approach will also be indicated. CA marks may be posted in NTU LEARN site.

After the Examination, an Examiners report is written and the group performance is highlighted and compared to the cohort's performance in similar subjects. This will be made known to you.

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
Lecture	Team-based learning (TBL) based course materials covering all topics
Tutorial	12 TBL classroom discussion sessions on tutorial questions and related topics

Reading and References

1. Mohan Ned, Undeland Tore M and Robbins William P, Power Electronics: Converters, Applications and Design, 3rd Edition, John Wiley, 2003. (TK7881.15.M697 2003)
2. Rashid M H, Power Electronics: Circuits, Devices & Applications, 3rd Edition, Pearson/Prentice Hall, 2004. (TK7881.15.r224 2004)

REFERENCES

1. Krein Philip T, Elements of Power Electronics, 1st Edition, Oxford University Press, 1998. (TK7881.15.K92)
2. Erickson Robert Warren and Maksimovic Dragan, Fundamentals of Power Electronics, 2nd Edition, Kluwer Academic/Springer, 2001. (TK7881.15.E68 2001)

Course Policies and Student Responsibilities

Refer to the following links for:

Course policies:
http://www.ntu.edu.sg/Students/Undergraduate/AcademicServices/Pages/AcademicUnitSystem(AUS).aspx

CA guidelines:

http://www.eee.ntu.edu.sg/Programmes/CurrentStudents/undergraduate/undergraduatefull-time/Pages/CourseRegistration.aspx

Instructions to Examination Candidates:
http://www.ntu.edu.sg/Students/Undergraduate/AcademicServices/Examination/pages/instructionstoexamcand.aspx

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
A/P. Ali I Maswood	S2-B2-A-30	6790-4847	Eamaswood@ntu.edu.sg
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Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Intro. to converter topologies.	1	Power Converters
2	Controlled & Uncontrolled devices, applications, drivers	1,2	Diode & Thyristor Devices, Gating & Control
3	Switching characteristics, RR characteristics, Converter design considerations	1,2	Current/voltage protections. Switch Protections
4	Single-Phase diode rectifiers, Performance parameters	1,2,3	AC-DC waveforms, Distortions
5	Three-Phase diode rectifiers, Performance parameters	1,2,3	Three phase balanced circuit AC-DC Conversion

6	Harmonic Mitigation in Converters	2,4	Harmonics, THD, PF
7	Introduction to Electrical Drives	3,4	PWM Technique
8	DC-DC buck converter	4	CCM, BCM of buck converter
9	DC-DC boost and buck-boost converters	4	CCM and BCM of boost and buck-boost converters
10	Bidirectional DC-DC converters	4	Bipolar and unipolar modulations
11	DC motor drives	4,5	Multi quadrant operation
12	Single-phase DC-AC inverters	3,4	Square wave modulation, phase-displacement modulation
13	Three-phase DC-AC inverters	3,4	Sinusoidal pulse-width modulation