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| **Course synopsis** | This course introduces students to the fundamentals of power electronics, which include power semiconductor switches, rectifier (AC-DC), choppers (DC-DC), and inverters (DC-AC). Emphasis will be on the power converter operations and analysis of their steady state performances. The course also exposes students to some basic converters design and the selection of suitable converters for certain application. In addition, the course covers the operation and selection of converters for DC and AC drive systems. At the end of the course student should be able to critically design power converters at given specification using application software. |
| **Course coordinator (if applicable)** | *Please fill in accordingly*  |
| **Course lecturer(s)** | **Name** | **Office** | **Contact no.** | **E-mail** |
| *Please fill in accordingly* |  |  |  |
|  |  |  |  |
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**Mapping of the Course Learning Outcomes (CLO) to the Programme Learning Outcomes (PLO), Teaching & Learning (T&L) methods and Assessment methods:**

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| --- | --- | --- | --- | --- | --- |
| **No.** | **CLO\*** | **PLO (Code)** | **\*\*Taxonomies****and****\*\*\*generic skills** | **Online T&L methods** | **\*\*\*\*Assessment methods** |
| CLO1 | Solve problems related to steady-state operation of power electronic converter circuits and motor drives | PLO3 (THI) | C3 | Lecture, active learning | T, Q, F |
| CLO2 | Design power converters based on the given specifications | PLO5 (THDS) | C6 | Project-based learning | T, F, PR |
| CLO3 | *Please fill in accordingly* |  |  |  |  |
| CLO4 | *Please fill in accordingly* |  |  |  |  |
| *This is the basic mapping required for the CI. Any added information is allowed (extra columns for weight or other elements)* ***provided*** *this is made consistent for all CI at program/school/faculty level.* *\*Up to 5 CLO**Refer \*\*Taxonomies of Learning and \*\*\*UTM’s Graduate Attributes for UG and Generic Skills for PG, where applicable for measurement of outcomes achievement*\*\*\*\*T – Test; Q – Quiz; HW – Homework; Asg – Assignment; PR – Project; Pr – Presentation; F – Final Exam etc. |

**Details on Innovative T&L practices:**

|  |  |  |
| --- | --- | --- |
| **No.** | **Type** | **Implementation** |
| 1. | Active learning | Conducted through in-class activities |
| 2.  | Project-based learning | Conducted through design assignments. Students in a group of 3 are given 2 design projects that require power electronics solutions involving the design calculations and verification using MATLAB/Simulink. Compliance to the design specifications need to be given in the form of written reports. |

**Topic Schedule:**

|  |  |  |
| --- | --- | --- |
| Topic | **Content** | **Teaching & Learning Activities** |
| Topic 1 | **Chapter 1. Introduction** Fundamental concepts of Power Electronics and Application | *Live Interaction with students* |
| Topic 2 | Power Devices, Switching and Related Issues (losses, heat sink, snubber, SOA) | *Students read a 5-page article online**Students carry out 1 collaborative learning task in online discussion board for separate groups based on article reading* |
| Topic 3 | Chapter 2. AC-DC Converters (Rectifiers) Diode Rectifiers, Controlled Rectifiers, Half-wave Single Phase with R load, R-L, and R-L with DC Source. | *Students write group findings on Padlet* *Students spent time on averagely 10 screens for all the activities* |
| Topic 4 | Full-wave Single Phase with R, R-L load. | *Live Interaction with students to discuss students’ work* |
| Topic 5 | Three Phase Rectifier (uncontrolled and controlled rectifiers). | *Students answer short online quiz* |
| Topic 6 | Application of Rectifier: DC Motor DrivesReview of Separately excited DC motor, Speed Control, 4-quadrant operation, Torque-Speed Curve |  |
| Topic 7 | DC motor Drives: SCR BasedVariable Speed Operation using alpha control. Single & three phase rectifier |  |
| Topic 9 | **DC-DC Converter (Choppers): Design Project 1**Non-isolated DC-DC Converters: Buck, Boost, Buck-boost. |  |
| Topic 10 | Isolated DC-DC Converter: Flyback, Forward, Half-Bridge, Full- Bridge  |  |
| Topic 11 | **Application of Chopper:** Chopper Based DC DrivesVariable Speed Operation using duty cycle control. |  |
| Topic 12 | Inverter 1. (DC- AC Converters): Design Project 2Fundamental of frequency conversion, single phase half and full bridge, three-phase inverter |  |
| Topic 13 | **Inverter 2:**Fourier Series and Harmonics (THD), PWM Strategies |  |
| Topic 14 | Voltage and Frequency control, three-phase PWM inverter, Review of Induction Motor |  |

**Transferable skills (generic skills learned in course of study which can be useful and utilised in other settings):**

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| --- |
| Team workingWritten communication |

**Student learning time (SLT) details:**

|  |  |  |  |
| --- | --- | --- | --- |
| Distributionof studentLearning Time (SLT) Coursecontent outline |  | Learning and Teaching Activities | TOTALSLT |
| Physical | Online / Technology-Mediated (Synchronous) | Guided Learning Non-Face to Face(Asynchronous) | Independent LearningNon-Face to face |  |
| **CLO** | **OL** | **T** | **P** | **O** | **OL** | **T** | **P** | **O** |  |  |  |
| CLO 1 |  |  |  |  | 6h |  |  | 4h | 16h | 42h | 78h |
| CLO 2 |  |  |  |  | 6h |  |  | 6h | 13h | 21h | 36h |
| Total SLT |  |  |  |  | 12h |  |  | 10h | 29h | 63h | **114h** |

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| --- | --- | --- | --- | --- | --- |
|  |  |  | F2F Assesment |  |  |
| Continuous Assessment | PLO | Percentage | Physical | Online / Technology-Mediated (Synchronous) | NF2F Independent Learning for Assesment (Asynchronous) | Total SLT |
| 1 | Quiz 1 | PLO3(THI) | 5% |  | **15m** |  | **15m** |
| 2 | Quiz 2 | PLO3(THI) | 5% |  | **15m** |  | **15m** |
| 3 | Quiz 3 | PLO5(THDS) | 5% |  | **15m** |  | **15m** |
| 4 | Quiz 4 | PLO3(THI) | 5% |  | **15m** |  | **15m** |
| 5 | Test 1 | PLO3(THI) | 10% |  | **1h15m** |  | **1h15m** |
| 6 | Test 2 | PLO3 (THI)PLO5 (THDS) | 5%5% |  | **1h15m** |  | **1h15m** |
| 7 | Design Project 1 | PLO5 (THDS) | 10% |  |  | As in CLO 2 (7h30m) | As in CLO 2 (7h30m) |
| 8 | Design Project 2 | PLO5 (THDS) | 20% |  |  | As in CLO2(7h30m) | As in CLO2(7h30m) |
| Final Assessment |  |  |  |  |  | Total SLT |
| 1 | Final Examination | PLO3 (THI)PLO5 (THDS) | 30% |  | **2h 30m** |  | **2h 30m** |
| **Grand Total SLT** | **100** |  | **120h** |
| **% SLT for Open and Distance Learning** | **100%** |
| **% SLT for Practical Component (Physical)** | **0%** |

OL: Online Lecture, T: Tutorial, P: Practical, O: OthersSpecial requirement to deliver the course (e.g: software, nursery, computer lab, simulation room):

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| --- |
| Computer lab with MATLAB/Simulink |

**Learning resources:**

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| --- |
| **Text book (if applicable)**Daniel W. Hart, Introduction to Power Electronics, Daniel W. Hart, McGraw Hill International Edition, 2011.**Main references**Mohan, Undeland and Robbins, Power Electronics: Converters, Applications and Design. 2nd Edition, John Wiley and Sons Inc., 1995.Muhammad H. Rashid, Power Electronics: Circuits, Devices & Applications., Prentice Hall, 2003.**Additional references** M D Singh, K B Khanchandani, Power Electronics, Tata McGraw Hill, 2nd Edition, 2007Gopal K. Dubey, Fundamental of Electrical Drives, Alpha Science International Ltd. 2001Mohamed A. El-Sharkawi, Fundamentals of Electrical Drives, Brooks/Cole, 2000**Online**[**http://elearning.utm.my**](http://elearning.utm.my) |

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| **Academic honesty and plagiarism:** *(Below is just a sample)*

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| Assignments are individual tasks and NOT group activities (UNLESS EXPLICITLY INDICATED AS GROUP ACTIVITIES) Copying of work (texts, simulation results etc.) from other students/groups or from other sources is not allowed. Brief quotations are allowed and then only if indicated as such. Existing texts should be reformulated with your own words used to explain what you have read. It is not acceptable to retype existing texts and just acknowledge the source as a reference. Be warned: students who submit copied work will obtain a mark of **zero** for the assignment and disciplinary steps may be taken by the Faculty. It is also unacceptable to do somebody else’s work, to lend your work to them or to make your work available to them to copy. |

**Other additional information (Course policy, any specific instruction etc.):**

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**Disclaimer:**

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| All teaching and learning materials associated with this course are for personal use only. The materials are intended for educational purposes only. Reproduction of the materials in any form for any purposes other than what it is intended for is prohibited. While every effort has been made to ensure the accuracy of the information supplied herein, Universiti Teknologi Malaysia cannot be held responsible for any errors or omissions.  |

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Note: This template has been filled in as a **sample** for a UG engineering program, please use the proper PLO code for other academic programs (Refer [Hasil Pembelajaran Program (PLO) UTM berdasarkan MQF 2.0](https://www.utm.my/office-dvcai/files/2020/04/KEYWORD-HASIL-PEMBELAJARAN-PROGRAM-PLO.pptx) at CIDU web page. |