



# HIGH POWER MULTILEVEL CONVERTERS- ANALYSIS, DESIGN AND OPERATIONAL ISSUES

**PROF. ANANDARUP DAS**

Department of Electrical Engineering  
IIT Delhi

**TYPE OF COURSE** : Rerun | Elective | UG

**COURSE DURATION** : 12 weeks (24 Jan' 22 - 15 Apr' 22)

**EXAM DATE** : 23 Apr 2022

**PRE-REQUISITES** : Power Electronics

**INTENDED AUDIENCE** : Interested Learners

**INDUSTRIES APPLICABLE TO** : Siemens, ABB, Alstom, NTPC and other industries working in power sector

**COURSE OUTLINE :**

The course covers different types of high power converters used in the industry for applications in HVDC, FACTS, Motor Drives and Power quality improvement. Traditional converters like NPC and emerging converters like modular multilevel converters will be covered. Operational issues and design considerations for these medium/high voltage high power converters will also be covered. The course will discuss many practical issues faced in the industry while designing and operating these converters.

**ABOUT INSTRUCTOR :**

Prof. Anandarup Das works as an Assistant Professor in the Department of Electrical Engineering, IIT Delhi. He works in high power electronics and motor drives for various applications in electrical industries. He worked for almost 3 years (2012 to 2014) in Siemens Power Electronics Centre (R&D) under Oil and Gas Division, Siemens, Norway as Senior Development Engineer. From 2010 to 2012, he was employed as a Post Doctoral Researcher at the Norwegian University of Science and Technology (NTNU), Trondheim, Norway. Dr. Anandarup Das did his PhD from Indian Institute of Science, Bangalore, India in 2010. He completed his masters from IIT Delhi in 2006 and Bachelor of Engineering from Indian Institute of Engineering Science and Technology (IEST)(formerly BESU/ Bengal Engineering College) in 2002.

**COURSE PLAN :**

**Week 1** : (a) Half bridge, Full bridge and three phase converters, sinusoidal PWM

**Week 2** : (a) 3rd harmonic addition, space vector PWM

**Week 3** : (a) Different types of multilevel converters (b) Cascaded H-Bridge converter – Basic operation

**Week 4** : (a) PWM Techniques for CHB converter (b) Fault tolerant operation of CHB converter

**Week 5** : (a) Modular Multilevel converter- Topology, operation and PWM

**Week 6** : (a) Capacitor voltage balancing in MMC (b) Design of components of MMC

**Week 7** : (a) NPC converter – Basic operation (b) NPC (3 level) Space vector diagram, (c) A case study of CHB and MMC (d) NPC converter – Basic operation

**Week 8** : NPC - PWM technique and midpoint balancing

**Week 9** : (a) NPC- midpoint voltage balancing (b) Multi-pulse transformer

**Week 10** : ((a) Clarke and Park transformation (b) Steady state modelling of grid connected voltage source converter

**Week 11** : (a) Dynamic modelling of grid connected voltage source converter (b) Gate driver circuit designing: turn on and turn off process

**Week 12** : (a) Other topologies : conclusion (b) Other topologies: conclusion