

**M.E. Electrical with
specialization in Power
Electronics and Drives**

Semester wise Pattern for Students Admitted to Higher Degree Programmes in the First Semester								
Year	First Semester			U	Second Semester			U
M.E. Electrical – Power Electronics and Drives								
I	EEE G542	Power Electronics Converter	5	BITS G540	Research Practice	4		
	EEE G541	Distribution Apparatus and Configuration	5	EEE G545	Control and Instrumentation Systems	5		
	EEE G543	Power Devices microelectronics and selection	3	EEE G552	Solid State Drives	5		
		Elective	*		Elective	*		
			18			17		
II	EEE G546	System Simulation	5	BITS G629T	Dissertation	16		
		Elective	*		or	Or		
		Elective	*	BITS G639	Practice School	20		
		Elective	*					
			14			16/20		

List of Core Courses

EEE G541	Distribution Apparatus and Configuration
EEE G542	Power Electronics Converter
EEE G543	Power Devices Microelectronics and Selection
EEE G545	Control and Instrumentation Systems
EEE G546	System Simulation Lab.
EEE G552	Solid State Drives

List of Elective Courses (Any Five)

BITS F462	Renewable Energy
CHE G526	Nuclear Engineering
EEE F422	Modern Control Systems
EEE F462	Advanced Power Systems
EEE G544	Steady-State and Dynamics of Electrical Motors
EEE G553	Utility Applications of Power Electronics
EEE G554	Soft Switching Converter Technologies
EEE G555	Transformer and Motor Design
EEE G557	Drives for Electric Traction
EEE G558	DSP based Implementation Drivers
EEE G593	Power Quality
MEL G622	Introduction to Artificial Neural networks

Course Descriptions

EEE G541 Distribution Apparatus and Configurations

[3 2 5]

The basic configuration of a distribution set-up at the consumer end. Transformer types, specifications, performance, protection, and sizing. Types of cables and insulation, cable parameters, ampacity, and protection. Ratings of LV switchgear and their use in selection, switching transients, and clearing time. Properties of fuses with reference to ampacity. Meters, instrument transformers, and their application. Voltage control at distribution levels. Elementary concepts of power quality power factor, frequency, and harmonic content

EEE G542 Power Electronic Converters

[3 2 5]

The importance of the converter is an interface between source and load. DC-DC converters: Buck, boost, and buck-boost configurations. ACDC converters: Diode and thyristor converters in single and three-phase. Inversion in thyristors converters and applications of line commutated inverters. DCAC converters: Switch mode voltage source inverters in single and three-phase, PWM operation of different types, VSI's operating in multi-levels, space vector modulation techniques. AC-AC converters: Thyristor fed AC loads, the cycloconverter. Matrix converter arrays and their operation as DC-DC and DC-AC converters.

EEE G543 Power Device Microelectronics and Selection

[3 0 3]

Thermal features of power device packaging, the issues of $R_{\theta JC}$ and $R_{\theta CS}$, heat flow, and effect on device temperature, heat sink design, and selection. The two-layer junction behavior, the concept of the drift region, characterization of power diodes. The base operation in a thick film BJT, steady-state characteristics, turn ON and turn OFF times, the multistage power Darlington. The four-layer junction behavior, two transistor model of a thyristor, dynamic model for a four-layer junction device. GTO thyristors, the turn OFF mechanism in four-layer junction devices, current technological problems. MOS operation and characteristics, characterization, and structure of the power MOSFET. Development of the MOSFET to IGBT, technological advantages, characterization, and dynamic behavior. Current technological problems in insulated gate technologies. Introduction to matrix converters.

EEE G545 Control and Instrumentation for Power Electronic Systems

[3 0 3]

The regulation and control problem with reference to power electronic converters. Converter models for feedback: basic converter dynamics, fast switching, piece-wise linear models, discrete-time models. Voltage mode and current mode control for DC-DC converters, comparator based control for rectifier systems, proportional and proportional-integral control applications. Control design based on linearisation: transfer functions, compensation, and filtering, compensated feedback control systems. Hysteresis control basics, and application to DC-DC converters and inverters. General boundary control: behavior near a boundary, and choice of suitable boundaries. Basic ideas of fuzzy control techniques, and performance issues. Sensors for power electronic circuits, speed, and torque transducers.

EEE G552 Solid State Drives

[3 2 5]

Introduction to the drive system: requirements, components, and benchmarks; Review of motor theory; Power electronic control of motors: requirements and operational issues; Static speed control of induction motors: the AC power controller, slip energy recovery, VSI, and CSI controlled induction motors; Speed control of synchronous motors and associated machines; The problem of DC motor speed control: rectifier and chopper controllers; Advanced induction motor drive control: vector control,

current modulation, the importance of microcontroller-based systems; Organisation of VI-95 microcontrollers: sensing and actuation of signals, interrupt handling and timing, a priority of tasks in a microcontroller drive system.

EEE G546 Systems Simulation Lab [4]

Simulation tutorial problems on single- and three-phase AC-DC converters, DC-DC buck-, boost-, and buck-boost converters, DC-AC inverters in single and three-phase with different levels of control complexity. Simulation of practical applications from utility and drives. May also include a small project.

BITS G540 Research Practice [4]

This course is designed to train the students towards acquiring competence in research methodologies. The course will be conducted in terms of actual participation in Research and Development Work. Each student will be assigned to a faculty member to work on specified projects. The student will be required to present some seminars in his research area in a structured manner.

BITS C462 Renewable Energy [3 0 3]

Introduction of renewable energy, advantages, potential, the status of development, broad details of different renewable energy systems such as solar, wind, biomass, micro hydel, geothermal, etc; Renewable energy development policy, Renewable energy industries, international co-operation, HRD, and career growth opportunities, consultancy areas and future thrust areas in renewable energy development.

EEE G544 Steady State and Dynamics of Electric Motors [3 2 5]

Direct current machines, dynamic characteristics of PM, and shunt DC motors. The Reference Frame theory balanced steady-state phasor relations and voltage equations. Symmetrical induction machines: commonly used reference frames and per-unit system, analysis of steady-state and dynamic operation, and free acceleration characteristics from different reference frames. Synchronous machines: equations in different reference frames, per-unit system, steady-state analysis, dynamic analysis for load changes, and faults. Brushless DC machines: voltage and microcontrollers: sensing and actuation of signals interrupt handling and timing, the priority of tasks in a microcontroller drive system

EEE G553 Utility Applications of Power Electronics [3 0 3]

Static excitation systems: converters as used in SES, control, and the IEEE types, enhancement of stability. HVDC transmission: configurations of line-commutated converters, constant current and constant extinction angle control at device terminal level, individual phase, and equidistant pulse firing control at the device level, active and reactive power considerations. FACTS: impedance type and inverter type FACTS devices, the static var compensator, the thyristor controlled series reactor, the STATCOM, and its developments in the form of UPFC and SSSC. Active filters: the power quality problems at the distribution level, inverter control by transient p-q theory, the configuration of active filters and their control, existing bottlenecks.

EEE G554 Soft Switching Converter Technologies [3 0 3]

Series, parallel, series-parallel resonant DC-DC converters, half and full-bridge topologies, analysis, and design. Sinusoidal analysis of resonant converters, soft switching, load resonant properties, exact characteristics. Soft switching mechanisms of semiconductor devices, zero current and zero voltage switching quasi-resonant converters, resonant switch topologies, soft switching in PWM converters and inverters, multi resonant converters, control of resonant and soft-switching converters, EMI suppression, snubbers, load resonant converters, passive components at high frequencies.