

**ELECTRICAL AUTOMATION  
SYSTEMS TOWARDS INTELLIGENT  
AND ENERGY EFFICIENCY  
APPLICATIONS**

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Musse Mohamud Ahmed



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**APPLICATIONS**

**Musse Mohamud Ahmed**

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## CONTENTS OF THE BOOK

<u>Chapter</u>	<u>Title &amp; Author</u>	<u>Page No</u>
<b>PART I: ELECTRICAL DISTRIBUTION AUTOMATION SYSTEMS</b>		
CHAPTER 1:	ELECTRICAL DISTRIBUTION SYSTEM ..... Musse Mohamud Ahmed and Soo Wai Lian	2
CHAPTER 2:	ELECTRIC DISTRIBUTION EQUIPMENT FAULTS..... Musse Mohamud Ahmed and Soo Wai Lian	6
CHAPTER 3:	FAULTS FROM TRADITIONAL TO AUTOMATION TECHNIQUES..... Musse Mohamud Ahmed and Soo Wai Lian	15
CHAPTER 4:	SCADA SYSTEM FOR ELECTRICAL DISTRIBUTION SYSTEM..... Musse Mohamud Ahmed and Soo Wai Lian	22
CHAPTER 5:	SCADA SOFTWARE DEVELOPMENT–INDUSOFT CASE STUDY..... Musse Mohamud Ahmed and Soo Wai Lian	25
CHAPTER 6:	PROTECTION SYSTEM FOR ELECTRICAL DISTRIBUTION..... Musse Mohamud Ahmed and Soo Wai Lian	37
CHAPTER 7:	RELAYS..... Musse Mohamud Ahmed and Soo Wai Lian	43
CHAPTER 8:	REMOTE TERMINAL UNIT (RTU)..... Musse Mohamud Ahmed and Soo Wai Lian	49
CHAPTER 9:	INTELLIGENT AUTOMATION SYSTEM: AUTOMATION HARDWARE DEVELOPMENT Musse Mohamud Ahmed and Soo Wai Lian	60
CHAPTER 10:	SCHEMATIC DIAGRAMS OF AUTOMATED SUBSTATION PANELS..... Musse Mohamud Ahmed and Soo Wai Lian	69
CHAPTER 11:	SOFTWARE AUTOMATION DEVELOPMENT ..... Musse Mohamud Ahmed and Soo Wai Lian	78
CHAPTER 12:	DEVELOPMENT OF MODBUS TCP/IP SETTING ..... Musse Mohamud Ahmed and Soo Wai Lian	87
CHAPTER 13:	POWER LINE CARRIER COMMUNICATION SYSTEM..... Musse Mohamud Ahmed and Soo Wai Lian	96
CHAPTER 14:	WIRELESS COMMUNICATIONS FOR ELECTRIC SYSTEM AUTOMATION..... Othman O. Khalifa and Musse Mohamud Ahmed	103
CHAPTER 15:	DEVELOPMENT OF AUTOMATION SYSTEM FOR SMALL/MEDIUM	

SCALE BIOMASS BASED RENEWABLE POWER PLANTS .....	108
Musse Mohamud Ahmed and Sheroz Khan	

<u>Chapter</u>	<u>Title &amp; Author</u>	<u>Page No</u>
----------------	---------------------------	----------------

**PART II: INTELLIGENT SYSTEMS USING COMMUNICATION AND ELECTRONICS SYSTEMS**

CHAPTER 16:	MODELING OF LOW VOLTAGE POWER LINE FOR DATA COMMUNICATION: SIMULATION RESULTS .....	118
	Amar Hazwani Binti Radzi, Wisatawati Darwis Harahap, Sheroz Khan, Musse Mohamud Ahmed and Khaizuran Abdullah	
CHAPTER 17:	LOW VOLTAGE POWERLINE ANALYSIS AND SIMULATION RESULTS.....	125
	Amar Hazwani Binti Radzi, Wisawati Darwis Harahap, Sheroz Khan, Musse Mohamud Ahmed and Khaizuran Abdullah.	
CHAPTER 18:	ZIGBEE APPLICATIONS TO WIRELESS COMMUNICATION SYSTEMS .....	133
	Hikma Shabani, Musse Mohamud Ahmed, Sheroz Khan and Rashid A. Saeed	
CHAPTER 19:	MODELING OF AN ENVIRONMENT FRIENDLY HYBRID ELECTRIC VEHICLE (HEV).....	138
	Musse Mohamud Ahmed, M. Habib Ullah, Teddy S. Gunawan, M. Raihan Sharif and Riza Muhida	
CHAPTER 20:	PIC 16F877A FOR HYBRID VEHICLE CONTROLLER .....	144
	Musse Mohamud Ahmed, M. Habib Ullah, Teddy S. Gunawan, M. Raihan Sharif, and Riza Muhida	
CHAPTER 21:	FPGA-BASED HARDWARE MODELING OF LIGHT RAIL TRANSIT FARE CARD CONTROLLER .....	155
	Musse Mohamud Ahmed, M. Raihan Sharif and M. Habib Ullah	
CHAPTER 22:	DEVELOPMENT OF A METHOD TO MAINTAIN TEMPERATURE AND HUMIDITY IN AN OPEN COMPOUND RESTAURANT .....	166
	M. Raihan Sharif and M. Habib Ullah, Musse Mohamud Ahmed	

**PART III: ENERGY EFFICIENCY APPLICATIONS TO ELECTRIC MOTORS AND FAN MOTORS**

CHAPTER 23:	ELECTRIC MOTOR .....	176
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 24:	LOSSES OF ELECTRIC MOTORS .....	180
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 25:	ELECTRIC MOTOR EFFICIENCY .....	185
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi	

and Che Fazilah Bt Fathil

CHAPTER 26:	ENERGY EFFICIENCY IMPLEMENTATION OF PERMANENT MAGNET SYNCHRONOUS MOTOR.....	191
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	

<u>Chapter</u>	<u>Title &amp; Author</u>	<u>Page No</u>
CHAPTER 27:	ENERGY CALCULATIONS.....	195
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 28:	MODELING, RESULT AND ANALYSIS .....	203
	Musse Mohamud Ahmed, Noor Zatil Amali Bt Muhammad Hanapi and Che Fazilah Bt Fathil	
CHAPTER 29:	AIR BLOWING EQUIPMENT .....	210
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 30:	ENERGY USAGE IN MALAYSIA.....	214
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 31:	FAN MOTOR EFFICIENCY REQUIREMENT.....	217
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 32:	APPLICATION OF FAN MOTOR ENEGY EFFICIENCY.....	220
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 33:	FAN EFFICIENCY GRADE (FEG) DEVELOPMENT STAGES.....	223
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 34:	FEG AND FMEG PRACTICAL CONSIDERATIONS - FAN SELECTIONS GUIDE .....	227
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	
CHAPTER 35:	RESULTS AND DISCUSSIONS.....	232
	Musse Mohamud Ahmed, Rafizah Rahmatullah and Syarifah Nur Zati Abdul Rashid	

## CHAPTER 17

### LOW VOLTAGE POWERLINE ANALYSIS AND SIMULATION RESULTS

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This chapter presents amplitude and phase responses of a case study project, the effect of length to the signal voltage attenuation, discussion and analysis, conclusion and references.

#### 17.1 Amplitude and Phase Responses of Case Study Project

Both the amplitude and phase response are significant parameters for a communications channel. The amplitude response determines the signal voltage attenuation, when the signal propagates through the channel from a transmitter to a receiver. Furthermore, the signal attenuation together with a signal to noise ratio and with the available bandwidth determine the maximum data transfer rate that can be theoretically attained. In addition to the amplitude response, the phase response is also an important parameter when considering the quality of the channel for digital communications. For the channel the linear phase response is desirable characteristics. Due to the phase nonlinearities, the waveform of the transmitted symbol changes when propagating through the channel from the sending point to the receiving point. This easily leads to synchronization errors if data are transmitted parallel using the multi carrier data transfer methods, as e.g. OFDM (orthogonal frequency division multiplexing). The linearity of the phase response is described by a term group delay or envelope delay  $\tau_g$  (Ahola, 2003):

$$\tau_g(f) = -\frac{1}{2\pi} \frac{d\theta(f)}{df} \quad (17.1)$$

where  $\theta$  describes the signal phase. With linear phased channel the group delay should be constant. The group delay is interpreted as the propagation time of a signal frequency component from the input to the output of the system (Proakis, 1996).

Simulation models were formed for the power-line channels of the pilot environment using the procedure and methods described in section 3.3. The simulated amplitude responses are illustrated in figures 3.7–3.10.