

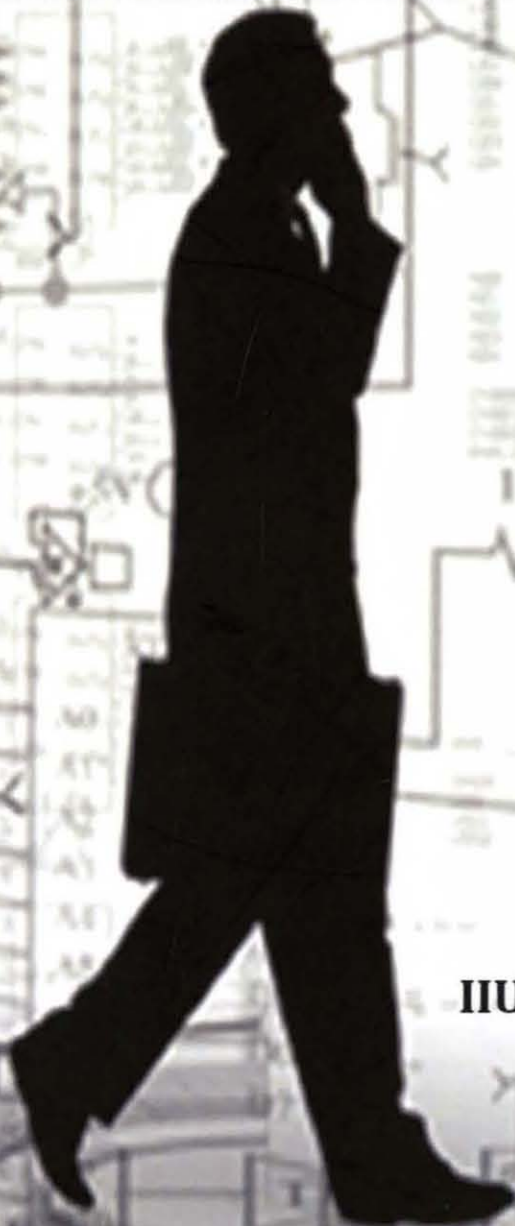
# PRINCIPLES OF TRANSDUCER DEVICES AND COMPONENTS

Edited by

**Sheroz Khan, International Islamic University Malaysia**

**Jalel Chebil, International Islamic University Malaysia**

**Othman O Khalifa, International Islamic University Malaysia**



**IIUM PRESS**

# **PRINCIPLES OF TRANSDUCER DEVICES AND COMPONENTS**

**Edited by**

**Sheroz Khan, International Islamic University Malaysia**

**Jalel Chebil, International Islamic University Malaysia**

**Othman O Khalifa, International Islamic University Malaysia**



**IIUM Press**

Published by:  
IIUM Press  
International Islamic University Malaysia

First Edition, 2011  
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Sheroz Khan, Jalal Chebil & Othman Khalifa: Principles of Transducer  
Devices and Components

ISBN: 978-967-418-172-7

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed By:  
**IIUM PRINTING SDN.BHD.**  
No. 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan  
Tel: **+603-6188 1542 / 44 / 45** Fax: **+603-6188 1543**  
EMAIL: [iiumprinting@yahoo.com](mailto:iiumprinting@yahoo.com)

## CONTENTS

Chapter		Page No.
1	RC CIRCUIT RESPONSE <i>Atika Arshad, Rumana Tasnim, Sheroz Khan, AHM Zahirul Alam</i>	1
2	RL CIRCUIT RESPONSE <i>Rumana Tasnim, Atika Arshad, Sheroz Khan, Musse Mohamod</i>	7
3	RLC CIRCUIT RESPONSE <i>Rumana Tasnim, Atika Arshad, Sheroz Khan, Musse Mohamod</i>	13
4	CAPACITIVE SENSING FOR NON-CONTACT MEANS OF MEASUREMENT <i>Rumana Tasnim, Atika Arshad, Sheroz Khan, Musse Mohamod, Nazmus Saquib</i>	19
5	SENSORS IN ELECTRONIC APPLICATIONS <i>Rumana Tasnim, Atika Arshad, Sheroz Khan, Musse Mohamod</i>	27
6	CONTACT TYPE AND NONCONTACT TYPE GAS FLOW MEASURING SENSORS <i>Rumana Tasnim, Atika Arshad, Nazmus Saquib, Sheroz Khan, Musse Mohamod</i>	33
7	OUTPUT CONTROL DEVICES: ACTUATORS <i>Rumana Tasnim, Atika Arshad, Sheroz Khan, Musse Mohamod</i>	39
8	INDUCTIVE POWER SYSTEM FOR ENERGY HARVESTING <i>Atika Arshad, Rumana Tasnim, Sheroz Khan, AHM Zahirul Alam</i>	45
9	ON THE ELECTRODE ARRANGEMENTS OF CAPACITIVE SENSOR FOR TWO PHASE GAS FLOW MEASUREMENT <i>Rumana Tasnim, Atika Arshad, Sheroz Khan, Musse Mohamod</i>	53
10	BASIC CONCEPT OF INDUCTANCE FOR INDUCTIVE TRANSDUCERS <i>Atika Arshad, Rumana Tasnim, Sheroz Khan, AHM Zahirul Alam</i>	59
11	MAGNETIC PROPERTIES FOR MAGNETIC TRANSDUCER <i>Atika Arshad, Rumana Tasnim, Sheroz Khan, AHM Zahirul Alam</i>	65
12	MAGNETIC, HYSTERESIS THEORY: APPLICATION PERSPECTIVE <i>Atika Arshad, Rumana Tasnim, Sheroz Khan, AHM Zahirul Alam</i>	71

13	THE PRINCIPLE OF RESISTIVE SENSING <i>Atika Arshad, Rumana Tasnim, Sheroz Khan, AHM Zahirul Alam</i>	75
14	SPIKES BLOCKING AND SURGE PROTECTION <i>Ahmad Lutfi Torla, Sheroz Khan, Asan Gani</i>	83
15	VOLTAGE SUPPLY AND VOLTAGE REGULATION <i>Ahmad Lutfi Torla, Sheroz Khan, Asan Gani</i>	89
16	FULL-WAVE RECTIFICATION OF A LOW-VOLTAGE SOURCE <i>Ahmad Lutfi Torla, Sheroz Khan, Asan Gani</i>	99
17	DESIGN OF DIFFERENTIAL RESISTIVE MEASURING SYSTEM AND ITS APPLICATIONS <i>Deji Abdulwahab, Sheroz Khan, Jalel Chebil</i>	107
18	LINEARIZING TECHNIQUES FOR SENSOR OUTPUT <i>Mohammad Tahir Siddiqi, Sheroz Khan, Ummer Siddiqi</i>	115
19	SENSOR AND SENSOR RESPONSE-ISSUES AND INTERFACING <i>Syed Masrur Ahmmad, Sheroz Khan, Anis Nurashinkin, Md Rasiuddin Khan</i>	119
20	UWB PULSE GENERATION SHAPING AND ANALYSIS <i>Zeeshan Shahid, Sheroz Khan, AHM Zahirul Alam</i>	133
21	POWER SUPPLY POWER-SUPPLY INTERFERENCE IN SMART SENSORS-TO-MICRONROLLER INTERFACE FOR BIOMEDICAL SIGNALS <i>Mohammad Ashraful, Sheroz Khan, Muhammad Ibrahimy</i>	139
22	RESPONSE AND INACCURACY ISSUES OF SENSORS <i>Mohammad Ashraful, Sheroz Khan, Muhammad Ibrahimy</i>	165
23	PERFORMANCE IMPROVEMENT OF SENSORS RESPONSE USING PIECE-WISE NON-LINEAR (PWL) A/D AND PULSE-WIDTH MODULATION (PWM) A/D TECHNIQUES <i>Ismaila Tijani, Sheroz Khan</i>	175
24	POWER SUPPLY INTERFERENCE IN SMART SENSOR MICROCONTROLLER INTERFACE <i>Ismaila Tijani, Sheroz Khan</i>	185

25	2.45 GHz PASSIVE RFID TAG ANTENNA MOUNTING ON VARIOUS PLATFORMS <i>Abubeker A. Yussuf, Md Rafiqul Islam, Sheroz Khan, Othman O. Khalifa, AHM Zahirul Alam</i>	201
26	ANALYSIS OF HYBRID STEPPER MOTOR PERFORMANCE UNDER THE INFLUENCE OF VOLTAGE SUPPLY INTERFERENCE <i>Abdulazeez F. Salami, Wahab A. Lawal, Sheroz Khan, Teddy Surya Gunawan, Sigit Puspito Wigati Jarot</i>	217
27	PC SOUND CARD BASED INSTRUMENTATION AND CONTROL <i>Teddy Surya Gunawan</i>	229
28	PIECE-WISE LINEAR ANALOG TO DIGITAL (PLADC) CONVERTER PROCESS <i>Abdulazeez F. Salami, Wahab A. Lawal, Sheroz Khan, AHM Zahirul Alam</i>	239
29	DESIGN AND IMPLEMENTATION OF AN OPTIMAL FUZZY LOGIC CONTROLLER USING EGENTIC ALGORITHM <i>Salami Femi Abdulazeez, Lawal Wahab Adetunji, Sheroz Khan, AHM Zahirul Alam, Momoh Jimoh E. Salami, Shihab Ahmed Hameed, Aisha Hasan Abdalla and Mohd Rafiqul Islam</i>	249
30	DESIGN AND HARDWARE IMPLEMENTATION OF CONDITIONING CIRCUIT FOR ACCURATE READING FROM TRANSDUCERS WITH NONLINEAR RESPONSES <i>Khairul Hasan, Aliza Aini Md Ralib, Ma Li Ya, Atika Arshad, Sheroz Khan</i>	265
31	TRANSDUCERS-TO-MICROCONTROLLER INTERFACES-SOFTWARE SOLUTION APPROACH <i>Lawal Wahab Adetunji, Salami Femi Abdulaziz, Sheroz Khan, AHM Zahirul Alam, Mohammad Rafiqul Islam, Shihab A. Hameed and Aisha Hasan Abdalla</i>	277
32	WAVELET ANALYSIS OF THE ECG SIGNALS FOR THREE COMMON HEART DISEASES IN JORDAN <i>Jalel Chebil, Jamal Al Nabulsi</i>	291
33	FUNCTIONAL ELECTRICAL STIMULATION SYSTEM AND PROFILE FOR WALKING <i>Noreha Abdul Malik</i>	303

34	FUZZY LOGIC BASED TEMPERATURE CONTROL OF THERMOELECTRIC COOLER FOR SINGLE PHOTON AVALANCHE DIODE APPLICATION <i>Nurul Izzati Samsuddin, Salmiah Ahmad, Nurul Fadzlin Hasbullah</i>	311
35	SPECTRUM SENSING FOR COGNITIVE RADIOS <i>Izyan Munyanti Abu Hanifah, Siti Natrah Che Rus, Sigit Puspito Wigati Jarot</i>	317
36	COGNITIVE RADIO VS INTELLIGENT ANTENNA <i>Siti Rabani Mat Nawati, Nurul Farhah Toha, Khaizuran Abdullah, M. Rafiqul Islam, Sheroz Khan</i>	327
37	APPLICATION AND CASE STUDIES OF MAGNETIC INDUCTION <i>Atika Arshad, Rumana Tasnim, Sheroz Khan, A H M Zahirul Alam</i>	341

## Chapter 11

# MAGNETIC PROPERTIES FOR MAGNETIC TRANSDUCER

ATIKA ARSHAD, RUMANA TASNIM, SHEROZ KHAN, AHM ZAHIRUL ALAM

### 11.0 INTRODUCTION

Knowing the basic terminology for describing magnetic effects and properties are essential since magnetic materials can be used in inductive sensors as in the form of core. The various types of magnetic behaviour and properties of hard and soft magnetic materials (used in inductive sensor) need to be identified in order to decide on the appropriate applications in biomedical and industrial field.

### 11.1 MAGNETIC MATERIALS

Magnetism is a well-known phenomenon by which some materials attract and others repel. Generally magnetic forces are generated by moving charged particles thus producing magnetic fields. The atomic movement in the material will respond to an external magnetic field. The external magnetic field is denoted by  $H$ , the magnetic induction in the material is denoted by  $B$  (tesla) and the magnetization by  $M$ .

$$B = \mu_0(H + M) \quad (11.1)$$

Where  $\mu_0$  is the permeability of free space and  $M$  is the magnetic moment  $m$  per unit volume of the material. The value of  $M$  depends on the type of material. Moreover every material responds differently to the force of a magnetic field. There are three main classifications of magnetic materials. A magnet will strongly attract ferromagnetic materials, weakly attract paramagnetic materials and weakly repel diamagnetic materials.

### 11.2 CLASSIFICATION OF MAGNETIC MATERIAL

A magnetic material falls under five different categories: diamagnetic, paramagnetic, ferromagnetic, anti-ferromagnetic, and ferri-magnetic, as shown in Figure 11.1 and Figure 11.2. Diamagnetic materials are those in which individual atoms or ions do not have net atomic or molecular movement, thus when diamagnetic material is placed in an external magnetizing field, it gets weakly magnetized in a direction opposite to the magnetizing field. Antimony, bismuth, copper, diamond, gold, mercury, silver, sulphur, tin and zinc are examples of diamagnetic material.