

# MICROWAVE ENGINEERING

**FIRST EDITION**

## Authors

**Dr. B. K. MADHAVI**

*Professor*

*Siddhartha Institute of Engineering and Technology  
Ibrahimpattanam, Hyderabad*

**Mr. M. SANDEEP KUMAR**

*Assistant Professor*

*Visvesvaraya College of Engineering & Technology  
M.P. Patelguda, Bonguloor 'x' Roads, Ibrahimpattanam Mandal,  
Ranga Reddy District-501510*

**Mr. T. KRISHNARAJA RAO**

*Assistant Professor*

*Siddhartha Institute of Engineering and Technology  
Ibrahimpattanam, Hyderabad*

**Ms. M. SHAMINI**

*Assistant Professor*

*Kasireddy Narayanreddy College of Engineering and Research,  
Abdullapur (V), Abdullapur (M), R.R. District,  
Hyderabad, Telangana- 501 505*

**Mr. JOBY JOSEPH**

*Assistant Associate Professor*

*TOMS College of Engineering,  
Mattakkara, Kottayam, Kerala*



**Title of the Book: MICROWAVE ENGINEERING**

**Edition: First - 2022**

**Copyrights © Authors/Editors**

No part of this text book may be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owners.

**Disclaimer**

The authors are solely responsible for the contents published in this text book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

**ISBN: 978-93-5762-052-9**

**MRP: Rs. 600/-**

**PUBLISHER & PRINTER: Alpha International Publication (AIP),  
3/725/2, Kammangudi, Adichapuram,**

**Thiruvarur District, Tamilnadu- 614717, INDIA**

**Email: [editoraipublications@gmail.com](mailto:editoraipublications@gmail.com)**

**Website: [www.alphainternationalpublication.com](http://www.alphainternationalpublication.com)**

## **PREFACE**

Abundance technical books on microwave and millimeter wave communication are available in the market and online, then why this kind of book again? Well, here is the emphasizing answer to this- it is not another book of that kind which is available in any forms nowadays!! This is the book which takes the reader from the basics of microwave communication, where the student's hunt of such a book comes to an end here. The book's overall approach, refined by the authors' experience with large sections of undergraduates from various universities, addresses the challenges of teaching and learning when prerequisite knowledge varies greatly from student to student. This book can be read by ordinary people with a limited, if any, scientific background. Throughout, the book has been written with this audience in mind. At times, the science presented might seem overwhelming: Some chapters are very light and can be easily understood by a layperson. One of the important features of this book is that it does not have a textbook structure when the chapters, in order to be understood, need to be read in the sequence given. In fact, you can start the journey from any chapter, based on your interests, tastes, and preferences. But I do hope that the information and knowledge presented here will become a wake-up call for the students who were eager to know the basics of microwave and millimeter wave circuits theory.

Spread across five simpler units for better understanding the contents, Chapter 1 illustrates the overview of the microwave transmission and outlines the basic concepts right from general microwave communication. It also briefly describes about the various modes and network parameters.

Chapter 2 describes about the various microwave passive devices, which includes the detailed explanation of their operation and construction. This chapter also examines the use of various active microwave devices along with the detailed explanation of construction and network parameters.

Chapter 3 starts with the introduction to wave propagation in microstrip lines. It also explains about the various discontinuities in waveguides and the obstacles. Furthermore, detailed description of microwave system is also provided along with the fundamental parameters.

Chapter 4 focuses right from the beginning in the periodic structures and their analysis. Later the paraphrasing shifts to the microwave filters and their implementation and transformations.

Chapter 5, the last chapter of the book, focuses on the importance of microwave and millimeter wave integrated circuits in modern technology. It provides an in-depth discussion about the applications and design considerations.

Even though extreme care has been taken while editorializing this book manuscript, there are chances that a few hidden errors that might have crept inadvertently. It's much obliged if these are pointed out to the author. Fundamental to a book's effectiveness is classroom use and feedback suggestions to improve the quality of the contents of the book will be highly appreciated.

## CONTENTS

<b>Chapter</b>	<b>TITLE</b>	<b>Page. No.</b>
<b>1</b>	<b>Microwave Transmission</b>	<b>1-48</b>
<b>2</b>	<b>Microwave Devices</b>	<b>49-110</b>
<b>3</b>	<b>Obstacles In Wave Guides and Microwave Systems</b>	<b>111-143</b>
<b>4</b>	<b>Filters And Periodic Structures</b>	<b>144-181</b>
<b>5</b>	<b>Millimetre Wave Circuits</b>	<b>182-217</b>

# **MODERN ELECTRIC VEHICLE TECHNOLOGIES**

**FIRST EDITION**

## **Authors**

**Ms. T. TEJASWINI**

*Assistant Professor*

*Visvesvaraya College of Engineering & Technology  
M.P. Patelguda, Bonguloor 'x' Roads, Ibrahimpatnam Mandal,  
Ranga Reddy District-501510*

**Mr. JOBIN JOHN**

*Assistant Associate Professor*

*TOMS College of Engineering,  
Mattakkara, Kottayam, Kerala*

**Mrs. MEKALA SUSHMITHA**

*Assistant Professor*

*Siddhartha Institute of Engineering and Technology  
Ibrahimpatnam, Hyderabad*

**Mr. P. PARUSHARAMULU**

*Assistant Professor*

*Siddhartha Institute of Engineering and Technology  
Ibrahimpatnam, Hyderabad*

**Mr. P. SRIDHAR**

*Assistant Professor*

*Brilliant Grammar School Educational Society's Group of  
Institutions, Abdullapur (V), Abdullapurmet(M), Rangareddy  
District, Hyderabad, Telangana State- 501 505*



**Title of the Book:** MODERN ELECTRIC VEHICLE TECHNOLOGIES

**Edition: First - 2022**

**Copyrights © Authors/Editors**

No part of this text book may be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owners.

**Disclaimer**

The authors are solely responsible for the contents published in this text book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

**ISBN: 978-93-5762-051-2**

**MRP: Rs. 600/-**

**PUBLISHER & PRINTER: Alpha International Publication (AIP),  
3/725/2, Kammangudi, Adichapuram,  
Thiruvarur District, Tamilnadu- 614717, INDIA**

**Email: [editoraippublications@gmail.com](mailto:editoraippublications@gmail.com)**

**Website: [www.alphainternationalpublication.com](http://www.alphainternationalpublication.com)**

<b>TABLE OF CONTENT</b>		
<b>S.NO</b>	<b>TITLE</b>	<b>PAGE.NO</b>
<b>UNIT : I INTRODUCTION TO ELECTRIC VEHICLES</b>		
<b>I</b>	1.1 INTRODUCTION:	1
	1.2 ELECTRIC VEHICLES:	4
	1.3 CONFIGURATIONS OF ELECTRIC VEHICLES:	4
	1.4 PERFORMANCE OF ELECTRIC VEHICLES:	9
	1.5 BATTERY-POWERED CAR EFFICIENCY:	9
	1.6 SPECIFICS OF A TRACTION MOTOR:	9
	1.7 TRACTIVE EFFORT AND TRANSMISSION REQUIREMENT	11
	1.9 TRACTIVE EFFORT IN NORMAL DRIVING	14
	1.10 ENERGY CONSUMPTION	15
	1.11 HYBRID ELECTRIC VEHICLES	15
	1.12 CONCEPT OF HYBRID ELECTRIC DRIVE TRAINS	16
	1.13 ARCHITECTURES OF HYBRID ELECTRIC DRIVE TRAINS	20
	1.14 CONTINUOUSLY VARIABLE TRANSMISSIONS FOR ELECTRIC AND	21



	HYBRID VEHICLES	
	1.15 THERE ARE MANY BENEFITS OF USING A SERIES HYBRID DRIVE TRAIN	23
	1.16 TO BE SURE, THERE ARE DRAWBACKS TO SERIES HYBRID ELECTRIC DRIVE TRAINS	24
	1.17 PARALLEL HYBRID ELECTRIC DRIVE TRAINS	24
	1.18 TORQUE-COUPLING PARALLEL HYBRID ELECTRIC DRIVE TRAINS	25
	1.19 PARALLEL HYBRID ELECTRIC DRIVE TRAINS WITH HIGH-VELOCITY COUPLING:	28
	1.20 MODES OF OPERATION THAT CAN BE MET INCLUDE THE FOLLOWING	30
	1.21 BATTERY CHARGING FROM THE ENGINE	31
<b>UNIT : II ENERGY STORAGE</b>		
II	2.1 INTRODUCTION	33
	2.2 ELECTRICAL RECHARGING	34
	2.3 OVERVIEW OF BATTERIES	35

2.4 BATTERY PARAMETERS	36
2.5 BATTERY TEMPERATURE, HEATING, AND COOLING NEEDS	39
2.6 BATTERY LIFE AND NUMBER OF DEEP CYCLES	39
2.7 TYPES OF BATTERIES	39
2.8 PRIMARY BATTERIES	40
2.9 CHARACTERISTICS OF COMMONLY USED RECHARGEABLE	44
2.10 TYPES AND CHARACTERISTICS OF SECONDARY BATTERIES	45
2.11 FEATURES OF ULTRACAPACITORS	52
2.12 HYBRIDIZATION OF ENERGY STORAGE	52
2.13 HYBRIDISED ENERGY STORAGE IS MADE UP OF TWO DISTINCT TYPES OF ENERGY STORAGE	53
2.14 DIFFICULTIES IN BATTERY PACK DESIGN	54
2.15 THE BMS WILL COLLECT NUMEROUS SENSOR READINGS	55

2.16 INCREASING THE DURABILITY OF BATTERIES	55
2.17 INTERVENTION IN THERMAL CONDITIONS	56
2.18 CIRCUIT PROTECTION CHALLENGES	57
2.19 INTERNATIONAL SYSTEM FOR CHARGING MOTOR VEHICLES	58
2.20 DETAILS OF BMS AND RESULT OF FAILURE	59
2.21 FUEL CELLS	60
2.22 OPERATING PRINCIPLES OF FUEL CELLS	61
2.23 FUEL CELL SYSTEM CHARACTERISTICS	63
2.24 TECHNOLOGIES FOR FUEL CELLS	65
2.25 POLYMER ELECTROLYTE MEMBRANE FUEL CELLS	65
2.26 DIRECT-METHANOL FUEL CELLS	66
2.27 ALKALINE FUEL CELLS	66
2.28 PHOSPHORIC ACID FUEL CELLS	67

	2.29 MOLTEN CARBONATE FUEL CELLS	67
	2.30 SOLID OXIDE FUEL CELLS	67
	2.31 COMBINED HEAT AND POWER FUEL CELLS:	69
	2.32 REGENERATIVE OR REVERSIBLE FUEL CELLS:	69
	2.33 FUEL SUPPLY:	69
	2.34 HYDROGEN ENERGY STORAGE:	69
	2.35 HOW HYDROGEN STORAGE WORKS:	70
<b>UNIT :III COMPONENTS OF ELECTRIC VEHICLES</b>		
III	3.1 ELECTRIC PROPULSION SYSTEMS	71
	3.2 DC MOTOR DRIVES	74
	3.3 PRINCIPLE OF OPERATION AND PERFORMANCE	75
	3.4 COMBINED ARMATURE VOLTAGE AND FIELD CONTROL	80
	3.5 DC MOTORS WITH A CHOPPER CONTROLLER	80

3.6 THE WAVEFORM HIGHLIGHTS THE FOLLOWING SALIENT FEATURES	83
3.7MULTI-QUADRANT CONTROL OF CHOPPER-FED DC MOTOR DRIVES	84
3.8 INDUCTION MOTOR DRIVES	84
3.9 A FIELD-ORIENTED INDUCTION MOTOR EMULATES A SEPARATELY EXCITED DC MOTOR IN TWO ASPECTS	88
3.10 CONTROL	88
3.11DIRECTION ROTOR FLUX ORIENTATION SCHEME	88
3.12 PERMANENT MAGNETIC BRUSH-LESS DC MOTOR DRIVES	89
3.13 BLDC MOTOR DRIVES WITH FAULTY INVERTERS	91
3.14 BASIC PRINCIPLES OF BLDC MOTOR DRIVES	92
3.15BLDC Machine Construction and Classification	93
3.16 SOME OF ITS BEST QUALITIES ARE AS FOLLOWS	95

	3.17 METHODS FOR EVALUATING AND MODULATING BLDC MACHINE PERFORMANCE	97
	3.18 EVALUATION OF RESULTS:	97
	3.19 SWITCHED RELUCTANCE MOTOR DRIVES	98
	3.20 BASIC MAGNETIC STRUCTURE	99
	3.21 PRODUCTION OF TORQUE	101
	3.22 SRM DRIVE CONVERTER	102
	3.23 DIFFERENT METHODS OF OPERATION	104
	3.24 GENERATING MODE OF OPERATION (REGENERATIVE BRAKING)	106
	3.25 SENSOR LESS CONTROL:	108
	3.26 PHASE FLUX LINKAGE-BASED METHODS:	110
	3.27 PHASE INDUCTANCE-BASED METHOD	110
<b>UNIT : IV MODELLING AND DESIGN OF ELECTRIC VEHICLES SYSTEM</b>		
IV	4.1 INTRODUCTION	111
	4.2 AUTOMOTIVE ELECTRIC DRIVES:	112

	4.3 ELECTRIC DRIVE APPLICATIONS	114
	4.4 CONTROLLER DESIGN	115
	4.5 VEHICLE STABILITY CONTROL	116
	4.6 SYSTEM OF DYNAMIC VEHICLE CONTROL	117
	4.7 REGULATOR OF VEHICULAR MOTION	119
<b>UNIT: V CHARGING METHODS</b>		
V	5.1 POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING	121
	5.2 CAUTIONARY NOTE	122
	5.3 CHARGING METHODS	123
	5.3.1 AC CHARGING	123
	5.3.2 DIRECT CURRENT (DC) CHARGING	124
	5.4 INDUCTIVE CHARGING	125
	5.5 BATTERY REPLACEMENT	125
	5.6 TECHNIQUES FOR RECHARGING	126
	5.7 COMMUNICATION:	128
	5.8 THE FOLLOWING TESTS ARE ALWAYS	128

	CARRIED OUT	
	5.9 LIMITATION OF THE CHARGING CURRENT	129
	5.9.1 EU SYSTEM	129
	5.9.2 CHARGING PLUGS	130
	5.9.3 CHARGING TIME	130
	5.10 POWER SEMICONDUCTORS	131
	5.11 DC/DC CONVERTERS AND PWM	134
	5.12 ISOLATION BETWEEN EV BATTERY AND GRID	134
	5.13 CONSERVATION OF ENERGY	135
	5.14 BUCK AND BOOST MODE OF OPERATION FOR THE BATTERY DC-DC CONVERTER	135
	5.15 BENEFITS OF INCREASED IN ELECTRIC VEHICLE DEPLOYMENT:	136
	5.16 CHALLENGES IN ELECTRIC VEHICLES:	137
	5.17 TRENDS AND FUTURE DEVELOPMENTS:	137



	5.18 DESIGN AND ANALYSIS OF MULTI-NODE CAN BUS FOR DIESEL HYBRID ELECTRIC VEHICLE	140
	5.18.1 COMPARATIVE STUDY OF CAN TOPOLOGY	140
	5.18.2 BRAKING MODE	141
	5.18.3 TRACTION MODE	141
	5.18.4 PARAMETRIC DESIGN	142

# RECENT TRENDS IN MECHANICAL ENGINEERING

**FIRST EDITION**

## Authors

**Mr. RUBEN JOSE TOM**

*Assistant Associate Professor  
TOMS College of Engineering,  
Mattakkara, Kottayam, Kerala*

**Mr. G. LINGAIAH**

*Assistant Professor  
Siddhartha Institute of Engineering and Technology  
Ibrahimpattanam, Hyderabad*

**Mr. N. PARSURAM**

*Assistant Professor  
Visvesvaraya College of Engineering & Technology  
M.P. Patelguda, Bonguloor 'x' Roads, Ibrahimpattanam Mandal,  
Ranga Reddy District-501510*

**Mrs. T. JYOTSNA SANTHI**

*Assistant Professor  
Visvesvaraya College of Engineering & Technology  
M.P. Patelguda, Bonguloor 'x' Roads, Ibrahimpattanam Mandal,  
Ranga Reddy District-501510*

**Mr. K. RAMA KRISHNA RAO**

*Assistant Professor  
Siddhartha Institute of Engineering and Technology  
Ibrahimpattanam, Hyderabad*



**Title of the Book:** RECENT TRENDS IN MECHANICAL ENGINEERING

**Edition:** First - 2022

**Copyrights © Authors/Editors**

No part of this text book may be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owners.

**Disclaimer**

The authors are solely responsible for the contents published in this text book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

**ISBN: 978-93-5762-040-6**

**MRP: Rs. 600/-**

**PUBLISHER & PRINTER: Alpha International Publication (AIP),  
3/725/2, Kammangudi, Adichapuram,  
Thiruvarur District, Tamilnadu- 614717, INDIA**

**Email: [editoraippublications@gmail.com](mailto:editoraippublications@gmail.com)**

**Website: [www.alphainternationalpublication.com](http://www.alphainternationalpublication.com)**

# Acknowledgment

First and foremost, praises to God, the Almighty, for his immense shower of blessing and kindness throughout the work and has allowed us to finish successfully.

We are sincerely grateful to our Institution Management, Director, Principal, Faculties, Students, and all our family members for providing continuous support and motivation during the work.

We would also like to take the opportunity to express our special thanks of gratitude to the publisher for providing a golden chance by giving us the most awaited platform to showcase our novel work.

Any attempt at any level can't be satisfactorily completed without our students' collaborative effort, resulting in our Book being unique.

# PREFACE

The technological advancements to be depicted in the course called emerging trends was a challenging task and therefore it was decided to prepare a learning material with the involvement of industrial and academic experts for its uniformity in the aspect of delivery, implementation and evaluation.

Over the coming years, technological developments such as Robotics, IOT, Artificial intelligence, smart controls are likely to have a significant impact on the world of work and employment. Looking towards the era in Technological advancement, Mechanical / Automobile / Production Engineering offers addition of new Dynamic subjects and new versions of core subjects. Diploma Mechanical/Automobile/Production Engineers should be familiar with new technologies from the fields of Automobile Engineering, HVAC, Energy Management, Advanced Manufacturing Processes, Agriculture and Farm Machines and many more. This Dynamic course will give insight to the recent practices adopted by the Mechanical Industries and awareness of these techniques will enhance career opportunities of Diploma Mechanical / Automobile / Production Engineers.

# CONTENT

<b>Chapter</b>	<b>Title</b>	<b>Page</b>
I	Recent Trends in Automobile Industry	1-24
II	Process Engineering	25-50
III	Recent Trends in Manufacturing in Industry	51-96
IV	Energy Audit and Management	97-140
V	Agriculture Equipment and Post-Harvest Technology	141-206
	References	207-208

# MACHINE LEARNING

**FIRST EDITION**

## Authors

**Ms. SHIJINA B**

*Assistant Associate Professor  
TOMS College of Engineering,  
Mattakkara, Kottayam, Kerala*

**Mr. P. RAGHU**

*Assistant Professor  
Siddhartha Institute of Engineering and Technology  
Ibrahimpattanam, Hyderabad*

**Mr. A. MAHESH**

*Assistant Professor  
Visvesvaraya College of Engineering & Technology  
M.P. Patelguda, Bonguloor 'x' Roads, Ibrahimpattanam Mandal,  
Ranga Reddy District-501510*

**Mr. D. SAIDAN**

*Assistant Professor  
Siddhartha Institute of Engineering and Technology  
Ibrahimpattanam, Hyderabad*



**Title of the Book: MACHINE LEARNING**

**Edition: First - 2022**

**Copyrights © Authors/Editors**

No part of this text book may be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owners.

**Disclaimer**

The authors are solely responsible for the contents published in this text book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

**ISBN: 978-93-5762-054-3**

**MRP: Rs. 600/-**

**PUBLISHER & PRINTER: Alpha International Publication (AIP),  
3/725/2, Kammangudi, Adichapuram,**

**Thiruvarur District, Tamilnadu- 614717, INDIA**

**Email: [editoraipublications@gmail.com](mailto:editoraipublications@gmail.com)**

**Website: [www.alphainternationalpublication.com](http://www.alphainternationalpublication.com)**



# PREFACE

Machine learning is transforming industries such as healthcare, education, transportation, food, entertainment, and diverse assembly lines, to name a few. It will have an impact on almost every aspect of people's lives, including their houses, transportation, shopping, food ordering, and so on. Because of developments in computer technology, machine learning today is not the same as machine learning in the past. It evolved from pattern recognition and the assumption that computers may learn without being instructed to do specific tasks; artificial intelligence researchers wanted to see if computers could learn from data.

Because models may change autonomously when they are exposed to new data, the iterative feature of machine learning is critical. They use earlier computations to deliver reliable, repeatable assessments and outputs. The same forces that have propelled data mining and Bayesian analysis to unprecedented heights are fueling renewed interest in machine learning. Things like increased data quantity and diversity, less expensive and more powerful computing processing, and low-cost data storage are examples.

This book not only covers the whole scope of the subject, but it also explores its philosophy. This increases knowledge and makes the subject more interesting. Both learners and researchers will find this book incredibly useful.

**CHAPTER 1** : It focuses on basic of machine learning systems followed by its perceptrons ,neural network ,feed forward neural network , supervised, unsupervised, and semi-supervised machine learning techniques, learning systems, perspectives and issues, and other topics.

**CHAPTER 2** : Discuss the decision tree method and identity, as well as how to avoid the overfitting problem, Neural Network Representation, Problems, Perceptron, Multilayer Networks, KNN and Curse Of Dimensionality

**CHAPTER 3** : Discuss and apply the generative learning algorithm to issues such as the Bayes Theorem, Nave Bayes Classifier, and Logistic regression

**CHAPTER 4** : Improve the various types of clustering ,K-Nearest Neighbour Learning, EM algorithm, latent semantic indexing

**CHAPTER 5** : Analyze and recommend relevant machine learning techniques for a variety of issues, including the Markov decision process , Bellman Equation, and various models.

# SYLLABUS

## UNIT 1 : INTRODUCTION TO MACHINE LEARNING

Learning Systems – Goals And Applications –Aspects Of Developing A Learning Systems- Training Data –Linear Perceptrons As Neurons-Neural Nets –Working –Layers –Activation Function –Feed Forward Neural Network –Limitations – Dbn’s –Deep Learning For Big Data – Local Minima-Rearranging Neurons – Spurious Local Minima –Comparison Of Ai – Machine Learning And Deep Learning

## UNIT II – TYPES OF LEARNING

Supervised Learning –Goals And Applications – Unsupervised Learning –Case Study –Classification –Mlp Is Practice –Overfitting –Linear And Non Linear Discriminative –Decision Tree –Probabilistic –K –Nearest Neighbour Learning Algorithm –Curse Of Dimensionality

## UNIT III –LEARNING ALGORITHMS

Logistic Regression –Perceptrons - Generative Learning Algorithm – Gaussian Discrimination Analysis –Naïve Bayes-Svm Kernels – Model Selction –Bagging Biisting –Evaluating And Debugging –Classification

## UNIT IV – UNSUPERVISED AND LEARNING ALGORITHMS

Clustering – Kmeans Clustering –Em Algorithm – Mixture Of Gaussian – Factor Analysis – Principal And Independent Component Analysis –Latent Semantic Indexing – Spectral Or Sub Space Clustering

## UNIT V -REINFORCEMENT LEARNING . IOT AND MACHINE LEARNING

Markov Decision Processes –Bellman Equation –Value Iteration And Policy Iteration –Linear Quadratic Regulation –Q Learning –Policy Versus Value Learning –Pomdps –Iot –Recent Trends –Various Models .Case Study ∴ Spam Filtering Based On Text Classification



<b>S.No</b>	<b>TABLE OF CONTENTS</b>	<b>PAGE NO</b>
<b>UNIT I -INTRODUCTION TO MACHINE LEARNING</b>		
<b>1</b>	<b>1.1 INTRODUCTION</b>	<b>1</b>
	1.1.1 FEATURES OF ML	<b>3</b>
	1.1.2 NEED FOR ML	<b>3</b>
<b>2</b>	<b>1.2 LEARNING SYSTEMS</b>	<b>4</b>
	1.2.1 Designing a Learning System in Machine Learning	<b>5</b>
<b>3</b>	<b>1.3 GOALS AND APPLICATION OF MACHINE LEARNING</b>	<b>7</b>
<b>4</b>	<b>1.4 ASPECTS OF DEVELOPING LEARNING SYSTEMS</b>	<b>11</b>
	1.4.1 TYPES OF MACHINE LEARNING	<b>12</b>
	1.4.1.1 SUPERVISED MACHINE LEARNING	<b>13</b>
	1.4.1.2 UNSUPERVISED MACHINE LEARNING	<b>16</b>
	1.4.1.3 SEMI SUPERVISED LEARNING	<b>18</b>
	1.4.1.4 REINFORCEMENT LEARNING	<b>19</b>
<b>5</b>	<b>1.5 TRAINING DATA IN MACHINE LEARNING</b>	<b>22</b>
	1.5.1 TRAINING DATA VS TESTING DATA IN MACHINE LEARNING	<b>22</b>
	1.5.2 GETTING AND COLLECTING TRAINING DATA	<b>23</b>
	1.5.3 MACHINE LEARNING METHODS RELY ON TRAINING DATA	<b>25</b>
	1.5.4 HUMAN IN THE LOOP AND THE QUALITY OF TRAINING DATA	<b>26</b>
	1.5.5 SEMI SUPERVISED LEARNING AND	<b>27</b>

	TRAININGDATA	
<b>6</b>	<b>1.6 LINEAR PERCEPTRONS AS NEURONS</b>	<b>27</b>
	1.6.1 ADAPTIVE LINEAR NEURON(ADALINE)	<b>28</b>
	1.6.1.1 ARCHITECTURE	<b>29</b>
	1.6.1.2 TRAINING ALGORITHM	<b>29</b>
	1.6.2 MULTIPLE ADAPTIVE LINEAR NEURON (MADALINE)	<b>30</b>
	1.6.2.1 ARCHITECTURE	<b>30</b>
	1.6.2.2 TRAINING ALGORITHM	<b>31</b>
<b>7</b>	<b>1.7 NEURAL NETWORKS</b>	<b>33</b>
	1.7.1 IMPORTANCE OF NEURAL NETWORKS	<b>33</b>
	1.7.2 BASICS OF NEURAL NETWORKS	<b>33</b>
	1.7.3 MULTI-LAYERED PERCEPTION	<b>34</b>
	1.7.4 APPLICATION OF NEURAL NETWORKS	<b>34</b>
	1.7.5 NEURAL NETWORK ARCHITECTURE	<b>35</b>
	1.7.6 NEURAL NETWORK ALGORITHMS	<b>37</b>
	1.7.7 PERCEPTRON DECISION SURFACE FOR NON LINEAR DATA	<b>38</b>
<b>8</b>	<b>1.8 ACTIVATION FUNCTION</b>	<b>40</b>
	1.8.1 NEED OF NON LINEAR ACTIVATION FUNCTIONS	<b>40</b>
	1.8.2 VARIANTS OF ACTIVATION FUNCTION	<b>42</b>
<b>9</b>	<b>1.9 FEEDFORWARD NEURAL NETWORKS</b>	<b>44</b>
	1.9.1 COMPONENTS OF FEEDFORWARD NEURAL NETWORKS	<b>45</b>
	1.9.2 FEEDFORWARD NEURAL NETWORK FUNCTION	<b>46</b>
	1.9.3 PHASES OF OPERATION IN THE	<b>47</b>

	FEEDFORWARD NEURAL NETWORK 1.9.4 ADAVANTAGES OF FEEDFORWARD NEURAL NETWORKS 1.9.5 LIMITATIONS OF FEED FORWARD NEURAL NETWORKS	<b>48</b>   <b>49</b>
<b>10</b>	<b>1.10 DEEP BELIEF NETWORK</b> 1.10.1 DEEP BELIEF NETWORK ARCHITECTURE 1.10.2 APPLICATIONS	<b>49</b> <b>49</b> <b>51</b>
<b>11</b>	<b>1..11 DEEP LEARNING FOR BIG DATA</b> 1.11.1 THREE APPLICATIONS OF DL IN BIG DATA ANALYSIS 1.11.2 SEMANTIC INDEXING 1.11.3 CONDUCTING DISCRIMINATIVE TASKS 1.11.4 SEMANTIC IMAGE AND VIDEO TAGGING	<b>52</b> <b>52</b> <b>52</b> <b>53</b> <b>53</b>
<b>12</b>	<b>1.12 LOCAL MINIMA</b>	<b>54</b>
<b>13</b>	<b>1.13 COMPARISION OF AI AND MACHINE LEARNING</b>	<b>54</b>
<b>14</b>	<b>1.14 MACHINE LEARNING AND DEEP LEARNING</b>	<b>56</b>
<b>15</b>	<b>TWO MARKS QUESTION AND ANSWERS</b>	<b>58</b>
<b>UNIT II –TYPES OF LEARNING</b>		
<b>1</b>	<b>2.1 INTRODUCTION</b>	<b>61</b>
<b>2</b>	<b>2.2 SUPERVISED MACHINE LEARNING</b> 2.2.1 CATEGORIES OF SUPERVISED MACHINE LEARNING 2.2.2 ADVANTAGES AND DISADVANTAGES OF SUPERVISED LEARNING	<b>62</b> <b>63</b> <b>64</b>

	2.2.3 GOALS OF SUPERVISED LEARNING	<b>64</b>
	2.2.4 APPLICATIONS OF SUPERVISED LEARNING	<b>64</b>
<b>3</b>	<b>2.3 UNSUPERVISED MACHINE LEARNING</b>	<b>65</b>
	2.3.1 CATEGORIES OF UNSUPERVISED LEARNING	<b>66</b>
	2.3.2 ADAVANTAGES AND DISADVANTAGES OF UNSUPERVISED LEARNING ALGORITHM	<b>67</b>
	2.3.2 APPLICATION OF UNSUPERIVSED LEARNING	<b>67</b>
<b>4</b>	<b>2.4 SEMISUPERVISED LEANRING</b>	<b>68</b>
	2.4.1 ADVANTAGES AND DISADVANTAGES OF SEMI SUPERVISED LEARNING	<b>69</b>
<b>5</b>	<b>2.5 REINFORCEMENT LEARNING</b>	<b>69</b>
	2.5.1 CATEGORIES OF REINFORCEMENT LEARNING	<b>70</b>
	2.5.2 USE CASES OF REINFORCEMENT LEARNING	<b>70</b>
	2.5.3 ADVANTAGES AND DISADVANTAGES OF REINFORCEMENT LEARNING	<b>71</b>
<b>6</b>	<b>2.6 CASE STUDY IN SUPERVISED LEARNING</b>	<b>71</b>
<b>7</b>	<b>2.7 CLASSIFICATION</b>	<b>72</b>
	2.7.1 THE CLASSIFICATION PROBLEMS: TWO TYPES OF LEARNERS	<b>73</b>
	2.7.2 TYPES OF ML CLASSIFICATION ALGORITHMS	<b>74</b>
	2.7.3 EVALUATING A CLASSIFICATION MODEL	<b>74</b>
	2.7.4 MULIT USE CASES OF CLASSIFICATION ALGORITHMS	<b>76</b>
	2.7.5 MULTI USE CASES OF CLASSIFICATION	<b>76</b>



	ALGORITHMS	
	<b>2.8 MULTI-LAYER PERCEPTRON</b>	<b>77</b>
<b>8</b>	2.8.1 WORKING OF MULTILAYER PERCEPTRON	<b>78</b>
	2.8.2 USE OF MULTI LAYER PERCEPTRON	<b>80</b>
	<b>2.9 UNDERFITTING</b>	<b>81</b>
<b>9</b>	2.9.1 GOODNESS OF FIT	<b>82</b>
	<b>2.10 OVERFITTING</b>	<b>83</b>
<b>10</b>	2.10.1 TO AVOID THE OVERFITTING IN MODEL	<b>84</b>
	2.10.2 GOOD FIT IN A STATISTICAL MODEL	<b>85</b>
	<b>2.11 LINEAR DISCRIMINANT ANALYSIS OR NORMAL</b>	<b>87</b>
	<b>2.12 DECISION TREE REPRESENTATION</b>	<b>91</b>
	2.12.1 APPROPRIATE PROBLEMS FOR DECISION TREE LEARNING	<b>93</b>
	2.12.2 THE BASIC DECISION TREE LEARNING ALGORITHM	<b>94</b>
<b>12</b>	2.12.3 NEED OF DECISION TREES	<b>95</b>
	2.12.4 DECISION TREE TERMINOLOGIES	<b>96</b>
	2.12.5 ATTRIIBUTE SELECTION MEASURES	<b>97</b>
	2.12.6 ISSEUES IN DECISION TREE LEARNING	<b>99</b>
	2.12.7 ADVANTAGES OF THE DECISION TREE	<b>102</b>
	2.12.8 DISADVANTAGES OF THE DECISION TREE	<b>102</b>
	<b>2.13 PROBABLISITIC</b>	<b>102</b>
<b>13</b>	2.13.1 THE SIGNIFICANCE OF PROBABILISTIC MACHINE LEARNING MODELS	<b>103</b>
	2.13.2 LEARNING AND PREDICTION ARE BOTH TYPES OF INFERENCE	<b>104</b>

	2.13.3 NAÏVE BAYES ALGORITHM	<b>104</b>
	2.13.4 TYPES OF NAÏVE BAYES MODEL	<b>105</b>
<b>14</b>	<b>2.14 K-NEAREST NEIGHBOR LEARNING</b>	<b>106</b>
	2.14.1 LEARNING ALGORITHMS	<b>106</b>
	2.14.2 PURPOSE OF KNN	<b>107</b>
	2.14.3 PROCESS OF KNN	<b>107</b>
	2.14.4 REQUIRED DATA PREPARATION	<b>110</b>
	2.14.5 K-NEAREST NEIGHBOR(KNN) ALGORITHM FOR MACHINE LEARNING	<b>110</b>
	2.14.6 NEED FOR KNN ALGORITHM	<b>111</b>
	2.14.7 STEPS OF KNN ALGORITHM	<b>112</b>
	2.14.8 TO SELECT THE VALUE OF K IN THE KNN ALGORITHM	<b>113</b>
	2.14.9 ADVANTAGES OF KNN ALGORITHM	<b>114</b>
	2.14.10 DISADVANTAGES OF KNN ALGORITHM	<b>114</b>
<b>15</b>	<b>2.15 CURSE OF DIMENSIONALITY</b>	<b>114</b>
	2.15.1. EFFECT OF CURSE OF DIMENSIONALITY ON DISTANCE FUNCTION	<b>116</b>
	2.15.2 SOLUTIONS OF CURSE OF DIMENSIONALITY	<b>117</b>
	2.15.3 OTHER METHODS	<b>117</b>
<b>16</b>	<b>TWO MARKS QUESTION AND ANSWERS</b>	<b>118</b>

<b>UNIT III –LEARNING ALGORITHMS</b>		
<b>1</b>	<b>3.1 LOGISTIC REGRESSION IN MACHINE LEARNING</b>	<b>121</b>
	3.1.1 LOGISTIC FUNCTION (SIGMOID FUNCTION)	<b>122</b>
	3.1.2 LOGISTIC REGRESSION EQUATION	<b>123</b>
	3.1.3 TYPES OF LOGISTIC REGRESSION	<b>123</b>

	<b>3.2 PERCEPTRON</b>	<b>124</b>
	3.2.1 ACTIVATION FUNCTION	<b>125</b>
	3.2.2 TYPES OF ACTIVATION FUNCTIONS	<b>125</b>
	3.2.3 WORKING OF PERCEPTRON	<b>126</b>
	3.2.4 TYPES OF PERCEPTRON MODELS	<b>127</b>
	3.2.4.1 SINGLE LAYER PERCEPTRON MODEL	<b>127</b>
	3.2.4.2 MULTI-LAYERED PERCEPTRON MODEL	<b>128</b>
	3.2.4.3 ADVANTAGES OF MULTI LAYER PERCEPTRON	<b>129</b>
	3.2.4.4 DISADVANTAGES OF MULTILAYER PERCEPTRON	<b>129</b>
	3.2.5 PERCEPTRON FUNCTION	<b>129</b>
	3.2.6 CHARACTERISTICS OF FUNCTION	<b>129</b>
	3.2.7LIMITATIONS OF PERCEPTRON MODEL	<b>130</b>
	<b>3.3 GENERATIVE LEARNING ALGORITHMS</b>	<b>131</b>
<b>3</b>	3.3.1 MATHEMATICAL THINGS INVOLVED IN GENERATIVE MODELS	<b>132</b>
	3.3.2 EXAMPLES OF GENERATIVE MODELS	<b>132</b>
<b>4</b>	<b>3.4 GAUSSIAN DISCRIMINANT ANALYSIS</b>	<b>133</b>
	<b>3.5 NAÏVE BAYES CLASIFIER</b>	<b>134</b>
	3.5.1 WORKING OF NAÏVE BAYES CLASSIFIER	<b>135</b>
	3.5.2 CONDITIONAL PROBABILITY	<b>136</b>
	3.5.3 JOINT PROBABILITY	<b>137</b>
<b>5</b>	3.5.4 ADVANTAGES OF NAÏVE BAYES CLASSIFIER	<b>140</b>
	3.5.5 DISADVANTAGES OF NAÏVE BAYES CLASSIFIER	<b>140</b>
	3.5.6 APPLICATIONS OF NAÏVE BAYES	<b>140</b>

	CLASSIFIER	
<b>6</b>	<b>3.6 SUPPORT VECTOR MACHINES</b>	<b>140</b>
	3.6.1 WORKING OF SVM	<b>140</b>
	3.6.2 SVM KERNELS	<b>141</b>
	3.6.3 TYPES OF SVM KERNEL	<b>142</b>
	3.6.4 SVM KERNELS	<b>143</b>
<b>7</b>	<b>3.7 MODEL SELECTION OF MACHINE LEARNING MODEL AND ALGORITHM</b>	<b>145</b>
	3.7.1 MODEL SELECTION IS A MANTRA	<b>145</b>
	3.7.2 MODEL SELECTION IN THE ML LIFE CYCLE	<b>145</b>
	3.7.3 TYPES OF MODEL SELECTION	<b>149</b>
<b>8</b>	<b>3.8 BAGGING</b>	<b>150</b>
	3.8.1 ADVANTAGES OF USING RANDOM FOREST TECHNIQUE	<b>151</b>
	3.8.2 DISADVANTAGES OF USING RANDOM FOREST TECHNIQUE	<b>151</b>
<b>9</b>	<b>3.9 BOOSTING</b>	<b>151</b>
	3.9.1 ADVANTAGES OF USING GRADIEMT BOOSTING METHODS	<b>151</b>
	3.9.2 DISADVANTAGES OF USING A GRADIENT BOOSTING METHODS	<b>151</b>
	3.9.3 DIFFERENCE BETWEEN BAGGING AND BOOSTING	<b>152</b>
<b>10</b>	<b>3.10 EVALUATING AND DEBUGGING</b>	<b>152</b>
	3.10.1 MODEL DEBUGGING EXPLANATION	<b>152</b>
	3.10.2 NEED OF BEBUGGING	<b>152</b>
	3.10.3 GENERAL STEPS FOR DEBUGGING	<b>153</b>
	3.10.4 MOST USED MODEL DEBUGGING STARTEGIES	<b>154</b>

	3.10.4.1 SENSITIVITY ANALYSIS	<b>154</b>
	3.10.4.2 RESIDUAL ANALYSIS	<b>154</b>
	3.10.4.3 BENCHMARK MODELS	<b>157</b>
	3.10.4.4 SECURITY AUDITS	<b>157</b>
	3.10.4.5 DATA AUGMENTATION	<b>158</b>
<b>11</b>	<b>3.11 CLASSIFICATION</b>	<b>159</b>
	3.11.1 TYPES OF ML CLASSIFICATION ALGORITHMS	<b>161</b>
	3.11.2 EVALUATING A CLASSIFICATION MODEL	<b>161</b>
	3.11.3 USE CASE OF CLASSIFICATION MODEL	<b>162</b>
<b>12</b>	<b>TWO MARKS QUESTION AND ANSWERS</b>	<b>164</b>

<b>UNIT IV –LEARNING ALGORITHMS</b>		
<b>1</b>	<b>4.1 CLUSTERING</b>	<b>167</b>
	4.1.1 TYPES OF CLUSTERING METHODS	<b>168</b>
	4.1.1.1 PARTITIONING CLUSTERING	<b>169</b>
	4.1.1.2 DENSITY BASED CLUSTERING	<b>169</b>
	4.1.1.3 DISTRIBUTION MODEL BASED CLUSTERING	<b>170</b>
	4.1.1.4 HIERARCHICAL CLUSTERING	<b>170</b>
	4.1.1.5 FUZZY CLUSTERING	<b>171</b>
	4.1.2 CLUSTERING ALGORITHMS	<b>171</b>
	4.1.3 APPLICATION OF CLUSTERING	<b>172</b>
<b>2</b>	<b>4.2 K-MEANS CLUSTERING</b>	<b>172</b>
	4.2.1 WORKING OF K-MEANS ALGORITHM	<b>174</b>
<b>3</b>	<b>4.3 EM ALGORITHM</b>	<b>178</b>

	4.3.1 FLOWCHART FOR EM ALGORITHM	<b>181</b>
	4.3.2 ADVANTAGES OF EM ALGORITHM	<b>182</b>
	4.3.3 DISADVANTAGES OF EM ALGORITHM	<b>182</b>
<b>4</b>	<b>4.4 MIXTURE OF GAUSSIAN</b>	<b>182</b>
	4.4.1 EXPECTATION -MAXIMIZATION METHOD IN RELATION TO GMM	<b>182</b>
	4.4.2 KEY STEPS OF USING GAUSSIAN MIXTURE MODELS	<b>183</b>
	4.4.3 USAGE OF GAUSSIAN MIXTURE MODELS	<b>183</b>
<b>5</b>	<b>4.5 FACTOR ANALYSIS</b>	<b>184</b>
	4.5.1 TYPES OF FACTOR ANALYSIS	<b>185</b>
	4.5.1.1 EXPLORATORY FACTOR ANALYSIS(EFA)	<b>185</b>
<b>6</b>	<b>4.6 PRINCIPAL AND INDEPENDENT COMPONENT ANALYSIS(ICA)</b>	<b>187</b>
	4.6.1 WORKING OF ICA	<b>188</b>
	4.6.2 INDEPENDENT COMPONENT ANALYSIS ASSUMPTIONS	<b>189</b>
	4.6.3 ICA IN MACHINE LEARNING	<b>189</b>
	4.6.4 APPLICATIONS OF ICA	<b>190</b>
	4.6.5 FUTURE OF ICA	<b>192</b>
<b>7</b>	<b>4.7 LATENT SEMANTIC INDEXING</b>	<b>192</b>
	4.7.1 LSI KEYWORDS	<b>193</b>
	4.7.2 METHOD TO CREATE LSI KEYWORDS	<b>193</b>
	4.7.3 USE OF LSI KEYWORDS	<b>194</b>
	4.7.4 IMPORTANCE OF LSI KEYWORDS	<b>194</b>
	4.7.5 WAYS TO IDENTIFY LSI KEYWORDS	<b>195</b>
	4.7.6 METHODS TO SELCET THE RIGHT LSI TERMS	<b>196</b>

	4.7.7 ADDITIONAL USES OF LSI LATENT SEMANTIC INDEXING	<b>198</b>
	4.7.8 BENEFITS OF USING LSI KEYWORDS	<b>199</b>
<b>8</b>	<b>4.8 SPECTRAL CLUSTERING</b> 4.8.1 STEPS FOR SPECTRAL CLUSTERING 4.8.2 SUBSPACE CLUSTERING	<b>199</b> <b>199</b> <b>201</b>
<b>9</b>	<b>TWO MARKS QUESTION AND ANSWERS</b>	<b>203</b>

<b>UNIT V –REINFORCEMENT LEARNING IOT AND MACHINE LEARNING</b>		
<b>1</b>	<b>5.1 MARKOV DECISION PROCESS(MDP)</b> 5.1.1 CHARACTERISTICS FOR MDPS 5.1.2 TYPES OF MARKOV MODELS 5.1.3 COMPONENTS OF MDPS	<b>207</b> <b>208</b> <b>208</b> <b>208</b>
<b>2</b>	<b>5.2 BELLMAN EQUATION</b>	<b>215</b>
<b>6</b>	<b>5.3 VALUE ITERATION AND POLICY ITERATION</b> 5.3.1 POLICY ITERATION 5.3.2 POLICY ENHANCEMENT 5.3.3 VALUE ITERATION	<b>215</b> <b>215</b> <b>216</b> <b>217</b>
<b>7</b>	<b>5.4 LINEAR QUADRATIC REGULATOR</b> 5.4.1 BACKWARD PASS 5.4.2 FORWARD PASS	<b>218</b> <b>222</b> <b>223</b>
<b>8</b>	<b>5.5 Q-LEARNING</b> 5.5.1 Q-VALUE 5.5.2 NON DETERMINISTIC REWARDS AND ACTIONS OF Q-LEARNING	<b>225</b> <b>225</b> <b>226</b>

	5.5.3 VALUE OF POLICY	<b>226</b>
	5.5.4 APPROACHES TO IMPLEMENT REINFORCEMENT LEARNING	<b>227</b>
<b>9</b>	<b>5.6 POLICY VERSUS VALUE LEARNING</b>	<b>227</b>
	5.6.1 ELEMENTS OF REINFORCEMENT LEARNING	228
<b>10</b>	<b>5.7 PARTIALLY OBSERVABLE MARKOV DECISION PROCESS</b>	<b>229</b>
	5.7.1 PACKAGE FUNCTIONALITY	<b>231</b>
<b>11</b>	<b>5.8 INTERNET OF THINGS(IOT)</b>	<b>233</b>
	5.8.1 MACHINE LEARNING WITH IOT	<b>233</b>
	5.8.2 USE OF MACHINE LEARNING FOR IOT	<b>233</b>
	5.8.3 BENEFITS OF MACHINE LEARNING INFERENE FOR IOT	<b>234</b>
	5.8.4 RAPID MODEL DEPLOYMENT TO OPERATIONALIZE MACINE LEARNING QUICKLY	<b>235</b>
	5.8.5 APPLICATIONS	<b>235</b>
<b>12</b>	<b>5.9 SPAM FILTERING BASED ON TEXT CLASSIFICATION</b>	<b>236</b>
	5.9.1 PROBLEM SETUP	<b>236</b>
	5.9.2 WORKFLOW FORTTEXT CLASSIFICATION	<b>236</b>
	5.9.3 WORKING STEPS	<b>237</b>
	5.9.4 IMPORTANCE OF TEXT CLASSIFICATION	<b>237</b>
	5.9.4.1 SCALABILITY	<b>238</b>
	5.9.4.2 REAL TIME ANALYSIS	<b>238</b>
	5.9.4.3 CONSISTENT CRITERIA	<b>238</b>
	5.9.5 MACHINE LEARNING TEXT CLASSIFICATION ALGROITHMS	<b>238</b>



	5.9.5.1 NAÏVE BAYES	<b>238</b>
	5.9.5.2 SUPPORT VECTOR MACHINES	<b>239</b>
<b>13</b>	<b>TWO MARKS QUESTION AND ANSWERS</b>	<b>242</b>

