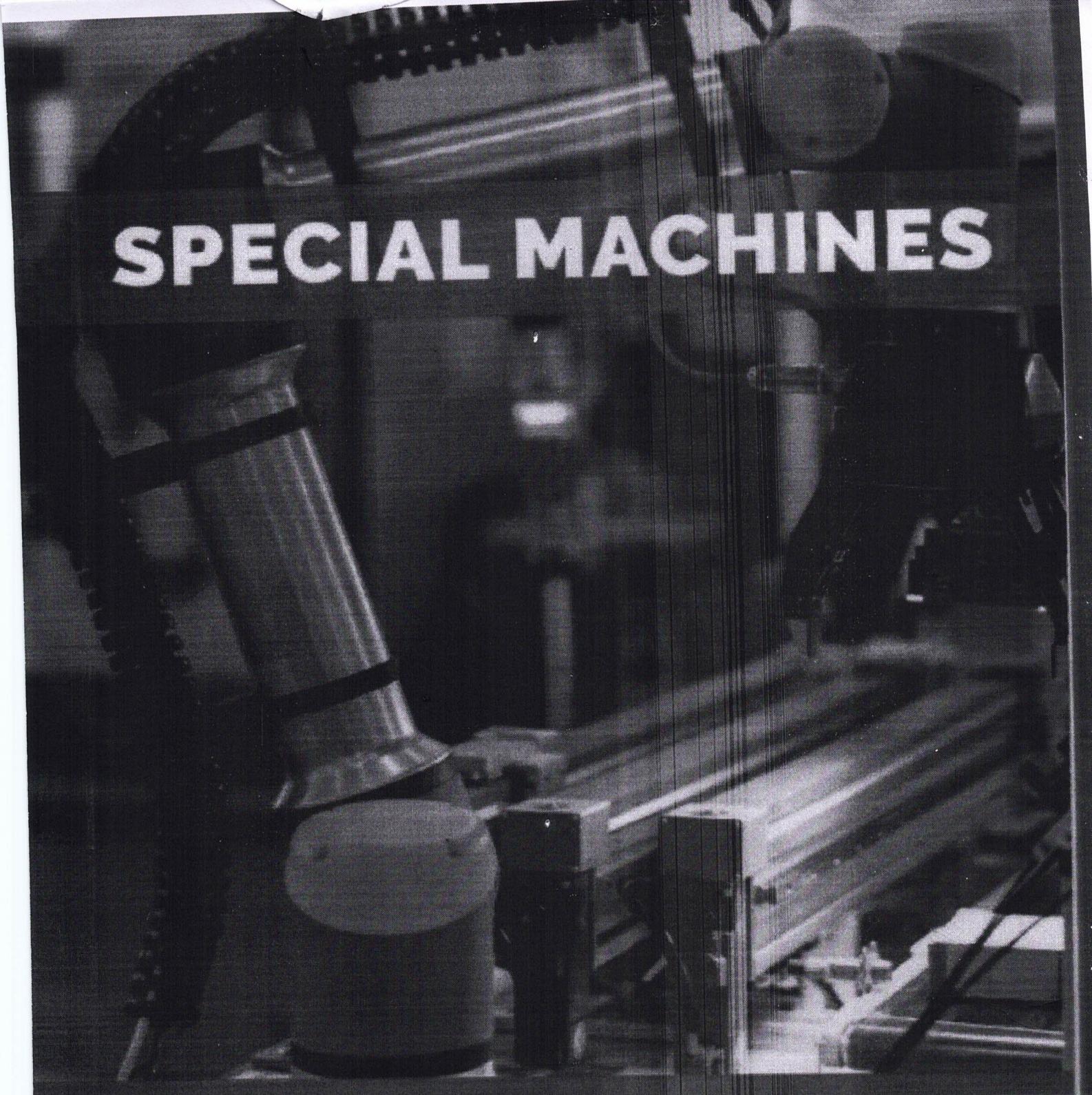


# SPECIAL MACHINES



**Dr. CHIDURALA SRINIVAS, Prof. A .NAGADEEPAN**

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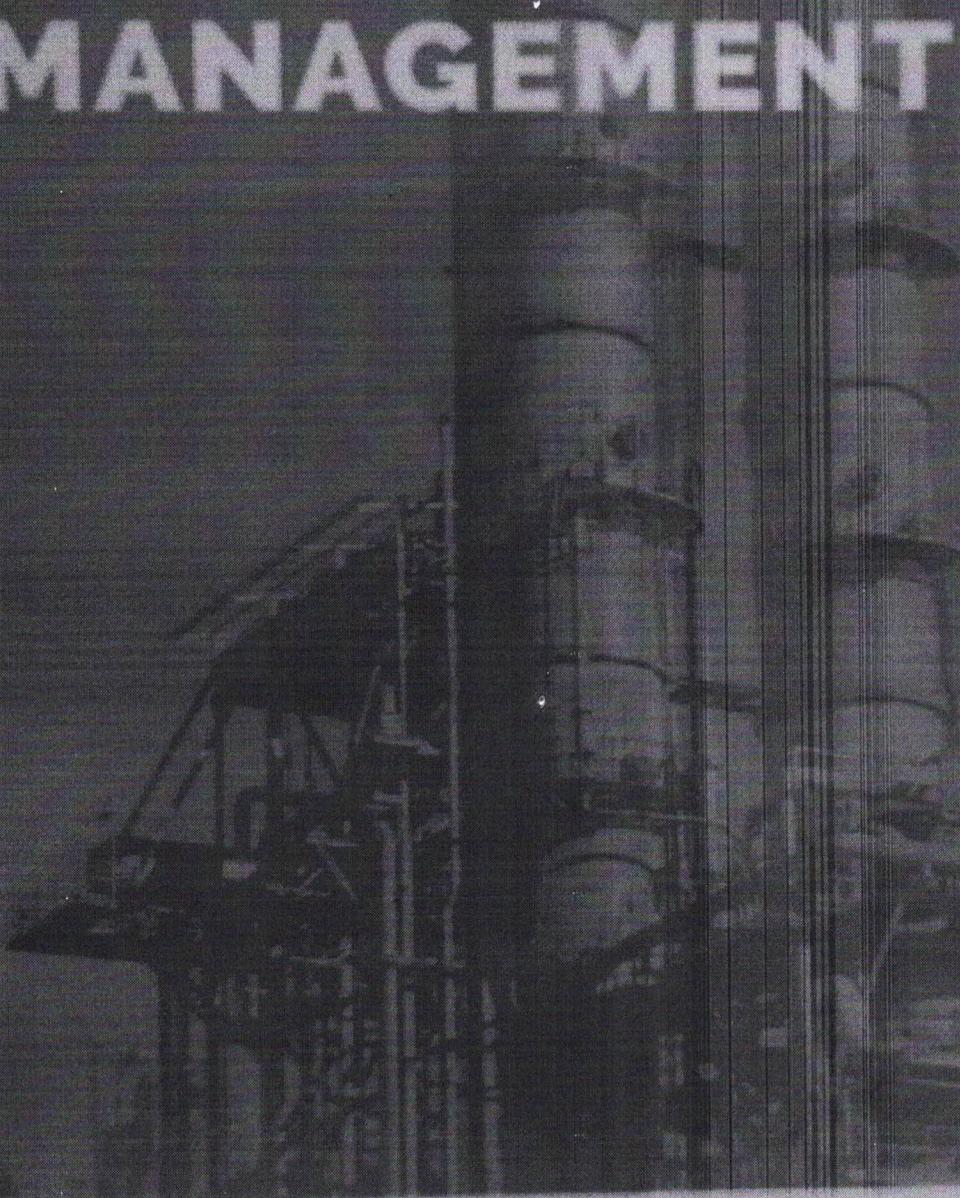


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# INDUSTRIAL ENGINEERING AND MANAGEMENT



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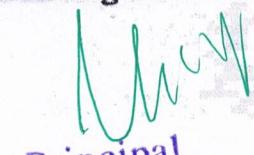
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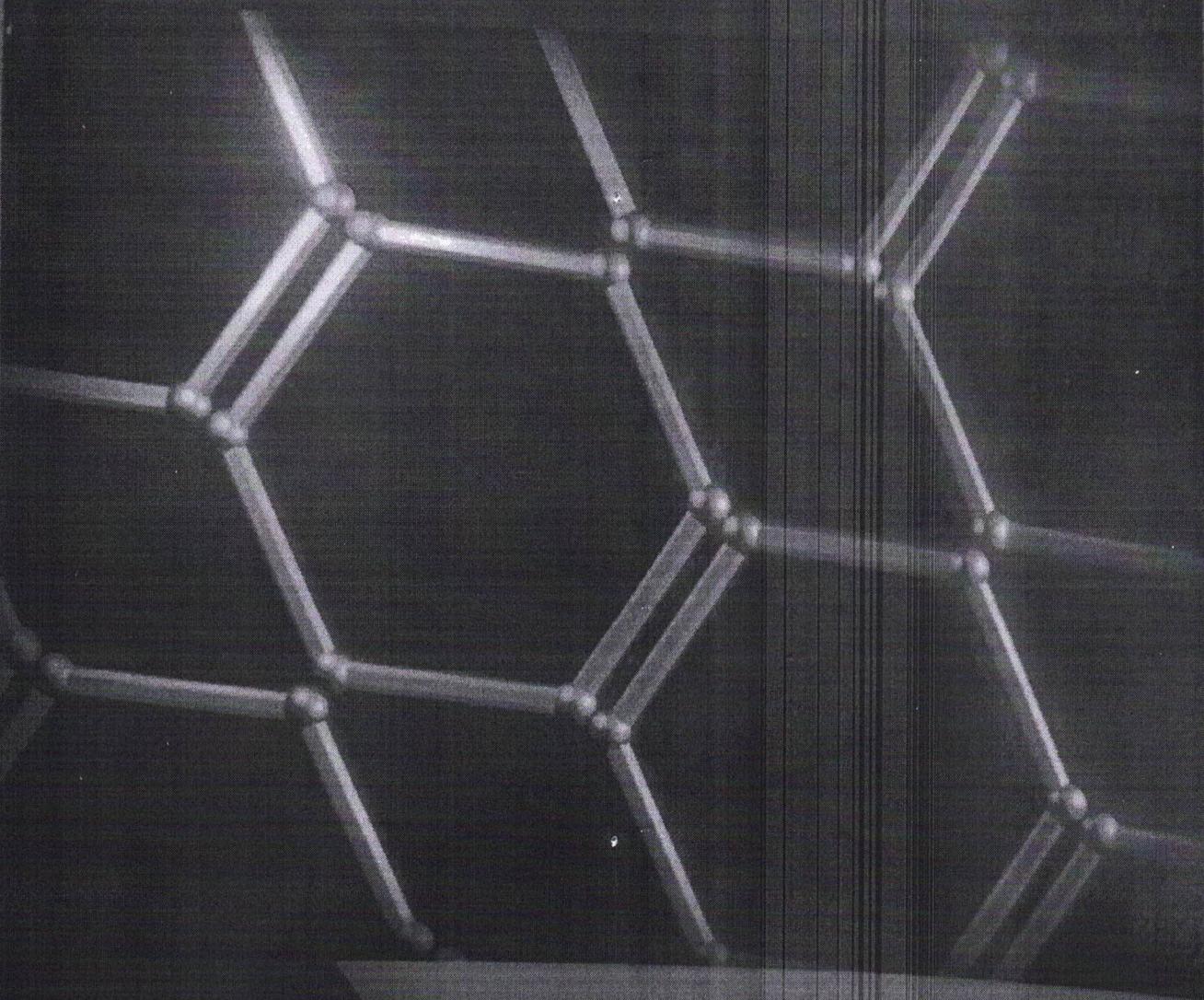
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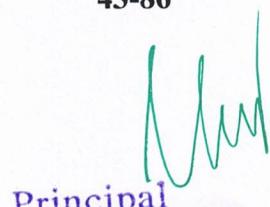
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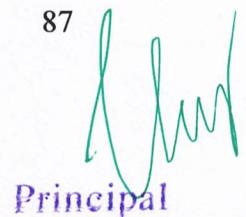
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# PROTECTION AND SWITCHGEAR

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# REAL-TIME CONCEPTS FOR EMBEDDED SYSTEMS

**FIRST EDITION**

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## SYLLABUS

### UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN

Complex systems and microprocessors- Embedded system design process -Design example: Model train controller- Design methodologies- Design flows - Requirement Analysis – Specifications- System analysis and architecture design - Quality Assurance techniques - Designing with computing platforms - consumer electronics architecture – platform-level performance analysis.

### UNIT II ARM PROCESSOR AND PERIPHERALS

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.

### UNIT III EMBEDDED PROGRAMMING

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

### UNIT IV REAL TIME SYSTEMS

Structure of a Real Time System — Estimating program run times – Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronization.

### UNIT V PROCESSES AND OPERATING SYSTEMS

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE. Distributed embedded systems – MPSoCs and shared memory multiprocessors. – Design Example - Audio player, Engine control unit – Video accelerator.

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# **SURVEYING**

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# TRANSPORTATION ENGINEERING

**FIRST EDITION**

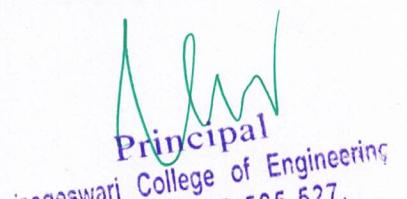
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# WEB DEVELOPMENTS

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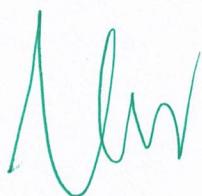
  
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# Preface

Internet has become the number one source to information, and many of the traditional software applications have become Web Applications. The methods by which computers communicate with each other through the use of markup languages and multimedia packages is known as web technology. Web Applications have become more powerful and can fully replace desktop application in most situations. It involves communication across the web, and create, deliver or manage web content using hypertext markup language (HTML).

Web development refers to the building, creating, and maintaining of websites. It includes aspects such as web design, web publishing, web programming, and database management. It is the creation of an application that works over the internet i.e. websites. The part of a website that the user interacts directly is termed as front end. It is also referred to as the 'client side' of the application. Backend is the server side of a website. It is used to store and arrange data.

This book enables the readers to understand web essentials, basic internet protocols, HTML tags and attributes, layout elements, forms including features from the current specifications for HTML5, CSS3 including selectors and rules, classes. This book gives demonstration about the document object model and of how to complete basic page manipulation using JavaScript. This book covers various aspects of JSP, XML, AJAX and web Services



## SYLLABUS

### UNIT I WEB SITE BASICS AND HTML

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients Web Servers. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables- Frames-Forms-HTML 5.0.

### UNIT II CSS AND CLIENT SIDE SCRIPTING

Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-CoreSyntax-Style Sheets and HTML- Style Rule Cascading and Inheritance-TextProperties-Box Model Normal Flow Box Layout-Beyond the Normal Flow-CSS3.0. Client-Side Programming: The JavaScript Language-History and Versions Introduction JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers.

### UNIT III SERVER SIDE SCRIPTING

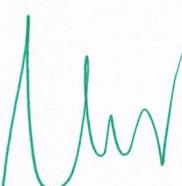
Host Objects: Browsers and the DOM-Introduction to the Document Object Model Document Tree-DOM Event Handling-Accommodating Noncompliant Browsers Properties of window. Server-Side Programming: Java Servlets- Architecture -Overview-A Servlet-Generating Dynamic Content-Life Cycle- Parameter Data-Sessions-Cookies-URL Rewriting-Other Capabilities-Data Storage Servlets and Concurrency- Databases and Java Servlets.

### UNIT IV JSP AND XML

Separating Programming and Presentation: JSP Technology Introduction-JSP and Servlets-Running JSP Applications Basic JSP-JavaBeans Classes and JSP- Tag Libraries and Files-Support for the Model-View-Controller Paradigm- Databases and JSP. Representing Web Data: XML-Documents and Vocabularies-Versions and Declaration-Namespaces- DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents- Selecting XML Data: XPATH-Template based Transformations: XSLT- Displaying XML Documents in Browsers.

### UNIT V AJAX AND WEB SERVICES

AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods. Web Services: JAX-RPC-Concepts-Writing a Java Web Service- Writing a Java Web Service Client-Describing Web Services: WSDL- Representing Data Types: XML Schema-Communicating Object Data: SOAP Related Technologies- Software Installation-Storing Java Objects as Files.



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# WIRELESS AND MOBILE COMMUNICATION

FIRST EDITION

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## Preface

This textbook takes a unified view of the fundamentals of wireless communication and explains the web of concepts underpinning these advances at a level accessible to an audience with a basic background in probability and digital communication. Topics covered include MIMO (multiple input multiple output) communication, space-time coding, opportunistic communication, OFDM and CDMA. Particular emphasis is placed on the interplay between concepts and their implementation in systems.

The book begins with an overview of wireless systems and standards. The characteristics of the wireless channel are then described, including their fundamental capacity limits. Various modulation, coding, and signal processing schemes are then discussed in detail, including state-of-the-art adaptive modulation, multicarrier, spread spectrum, and multiple antenna techniques. An abundant supply of exercises and figures reinforce the material in the text. This book is intended for use on graduate courses in electrical and computer engineering and will also be of great interest to practicing engineers.

Wireless technology is a truly revolutionary paradigm shift, enabling multimedia communications between people and devices from any location. It also underpins exciting applications such as sensor networks, smart homes, telemedicine, and automated highways.

This book provides a comprehensive introduction to the underlying theory, design techniques and analytical tools of wireless communications, focusing primarily on the core principles of wireless system design.

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# **SPECIAL ELECTRICAL MACHINES**

**FIRST EDITION**

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## SYLLABUS

### 1. MANUFACTURING OF PLASTIC COMPONENTS

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Milling Machines: Types - column and knee type – plain - universal milling machine - vertical milling machine - principles of operation - specification of milling machines - work holding devices - tool holding devices - arbor - stub arbor - spring collet – adapter. Milling cutters: cylindrical milling cutter - slitting cutter -side milling cutter - angle milling cutter - T-

slot milling cutter - woodruff milling cutter - fly cutter - nomenclature of cylindrical milling cutter.

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#### **4. ABRASIVE PROCESS AND NON- CONVENTIONAL MACHINING PROCESSES**

Abrasive Process: Types and classification – specifications - rough grinding – pedestal grinders - portable grinders - belt grinders - precision grinding - cylindrical grinder - centerless grinders – surface grinder - tool and cutter grinder - planetary grinders - principles of operations - grinding wheels – abrasives - natural and artificial diamond wheels - types of bonds - grit, grade and structure of wheels - wheel shapes and sizes - standard marking systems of grinding wheels - selection of grinding wheel - mounting of grinding wheels - Dressing and Truing of wheels - Balancing of grinding wheels.

Non-Conventional Machining Processes: Construction, working and applications of Ultrasonic machining - chemical machining - electro chemical grinding - electrical discharge machining - plasma arc machining - LASER machining - Advantages – Disadvantages.

#### **5. CNC MACHINE AND ITS COMPONENTS**

CNC Machines: Numerical control – definition – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centre – machine axes conventions turning centre and machining centre – Coordinate measuring machine – construction and working principle. Components of CNC machine: Slide ways – requirement – types – friction slide ways and antifriction slide ways - linear motion bearings – recirculation ball screw – ATC – tool magazine – feedback devices – linear and rotary transducers –Encoders - in process probing - tool material – tool inserts.

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# Reinforcement Learning and Heuristic Algorithms for Efficient Routing Protocols in Mobile Ad-Hoc Networks: An Advanced Approach

**D. Srinivas Reddy<sup>1</sup>, V. Bapuji<sup>1\*</sup> and A. Govardhan<sup>2</sup>**

DOI: 10.9734/bpi/ramrcs/v3/5275F

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## Abstract

In mobile ad-hoc networks nodes are freely move and communicate with each other in its frequency range wirelessly. Due to dynamic topology the routes are not stable. Hence transmitting data packets among nodes is one of the major challenge. The algorithms compatible with the changes created in the network due to the nodes' movements are of high significance. For reducing data packet transmission time among nodes, route shortness and also route stability should be taken into consideration. More than a decade ago, that our approach to Artificial Intelligence has been widely accepted as a new development in the field of routing protocols [1,2]. In order to select the robust routing process, the reinforcement learning was used to make the best choice among the neighbor nodes at any moment to transmit data packets from source to destination. It predicts the behavior pattern of the nodes in relation to the target node through using reinforcement learning. The proposed method adopts Q-learning algorithm which has more homogeneity to estimate the value of actions [3].

**Keywords:** MANETs; DSR; QoS; RLTA; Q-learning; ACO; MP-DSR; EMP-DSR.

## 1 Introduction

A freely moving autonomous nodes communicating with each other without any underlying infrastructure, are termed as MANETs. Due to mobile in nature and depending on the local conditions, the transfer of data packets in MANETs is not stable. For transmission of data packets, the establishment of a route from source to destination is a major task. Due to the un-stability of the nodes, the change of routing path and establishing a new path not only increases the packet delivery time, but also consumes more energy resources as well as creates traffic overhead [4].

These distinguished features like, low bandwidth of channel transmission rate, limited features of nodes, dynamic topology and limited battery power makes MANETs distinguished from other networks. Hence, these highlighted features are to be addressed with new methods in designing and operations of routing protocols [5-8].

## 2 Data Forwarding Methods

The forwarding of data packets is done by two methods.

### 2.1 Source routing

In source routing or proactive routing protocol, the header of the packet contains the complete routing information from origin to the destination. Hosts are free and they need not maintain any routing information. All the routing information is maintained by the source host in.

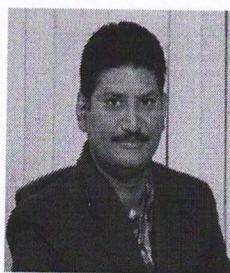
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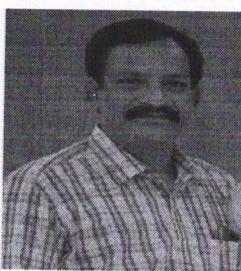
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# Application of Artificial Intelligence Control of HVDC Transmission System

M. Ramesh<sup>1\*</sup> and A. Jaya Laxmi<sup>2</sup>

DOI: 10.9734/bpi/ramrcs/v3/5276F

## Abstract

To handle bulk of power, the AC power transmission is not economical over long distance. High-voltage direct current (HVDC) transmission system is selected as the alternative not only in economic aspects but also in stability point of view. But the operation and control of HVDC links pose a challenge for the designers to choose the proper control strategy under various operating conditions. Traditionally, PI controllers are used for the rectifier current control of the HVDC system, but due to fixed proportional (P) and integral (I) gains, these controllers can perform well only over a limited operating range. However, in controlling a nonlinear plant such as the firing angle of the rectifier side in HVDC system, the model controls such as fuzzy logic controllers show better performance to the dynamic disturbances than traditional PI controllers. The CIGRÉ model as one of the conventional methods has been studied and improves the stability HVDC system.

**Keywords:** HVDC transmission; CIGRÉ benchmark model; Faults in HVDC system; Proportional integral (PI) controller; Fuzzy logic controller (FLC).

## 1 Introduction

The latest development in control of HVDC transmission system is the introduction of AI techniques of fuzzy, neural, genetic and expert system. These have exhibited inherent superiority over conventional control system. Conventionally PI controller is the one which is widely used for the HVDC system. Parameter variations in real time plant operation are well suited for PI controller but optimization is difficult, components such as transformers, converters and filters which make the HVDC systems highly nonlinear and complex in nature [1-5]. Harmonics generated by converters which can interfere with the controller, AC/DC filters are used for harmonic elimination. An alternative method of performance enhancement is the tuning of PI controller in all operating conditions and also during faults and disturbances occur.

Superiority of mathematical based models is blemished by the highly complex nature and nonlinear nature of the system causing inaccurate mathematical representation. To overcome this difficulty AI methods have proved to be a game changer, providing high quality at low cost. Design is simplified by just defining the qualitative parameters [6-10]. The expert knowledge, the ability to utilize the output of FLC for DC control, short term overloads can result, when the overload rating of converter is a result of control effectiveness the control simulation of AI based methods like FL, ANN and ANFIS have proved to be better than PI controller [11].

The application of an effective and intelligent current controller designed using AI techniques like FL, NN and NFL improves the gain of a HVDC transmission system [12]. The block diagram of HVDC system with AI controller is shown in Fig. 1.

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# LEADERSHIP

.....*For Organizational Excellence*

PROF. ANAND PAWAR



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**Title: Leadership for Organizational Excellence**

**Editor: Prof. Anand Pawar**

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**ABSTRACT**

Leadership has a direct cause and effect relationship upon organizations and their success. Generally it is believed that the Leaders determine the organizational performance by ad-haring certain values, creating work culture, cultivating the habit of change management with at most tolerance and employee morale. They shape institutional strategies including their execution and effectiveness. Leaders can appear at any level of an organization and are not exclusive to management. Successful leaders do, however, have one thing in common. They influence those around them in order to reap maximum benefit from the organization's resources, including its most vital and expensive: its people.

In this back drop, this study aims at to investigate the effect of leadership style on representative execution and leading to employee performance. The investigation embraced a blended technique approach and utilizes an exploratory study. A survey was utilized to elicit the information from the sample respondents from the select few IT & ITES Companies in Hyderabad. The study revealed that 132 of the respondents out of total 200 target sample opined as strongly agree with the Transactional leadership style which plays an important role in identifying and improving the employees' performance, followed by 33 of them agreed with the Laissez-faire leadership, there are 18 of respondents have agreed with Autocratic Leadership style and there are another 22 of them have agreed with Democratic leadership and therefore it is concluded that the two leadership styles were identified as most effective in enhancing the performance of employees according to this study.

**Keywords:** Autocratic Leadership, Democratic Leadership, Transactional Leadership, Laissez-faire Leadership, Employee Performance, Leadership Styles.



BANKING

# INDIAN BANKING

Insights and Perspectives

Prof. Anand Pawar



 Bharti

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**Title: Indian Banking: Insights and Perspectives**

**Editor: Prof. Anand Pawar**

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**ABSTRACT**

Since the inception, Regional Rural Banks (RRBs) play a significant role in the development of rural areas in India by providing needed financial assistance to agriculture, trade, commerce, industry and other productive activities in the rural areas. Credit and other financial facilities are extended particularly to small and marginal farmers, agricultural laborers, artisans, and small entrepreneurs with a view to strengthening these activities in rural areas. The RRBs have more reached to the rural area of India, through their huge branch network. Now, RRBs become key financial institutions at the rural level which shoulders responsibility of fulfilling the rural needs of different types of agriculture credit in rural areas. Telangana Grameena Bank (TGB) is one of the rural banks in Telangana state showing good performance in respect of deposits and advances, profitability and non-performing assets (NPAs) in backward district of the state. The present study examines the performance of the RRB (TGB) by analyzing the key performance indicators such as number of banks branches, deposits, advances, priority sector lending, profitability of the bank and NPAs during the period of 10 years from 2011 – 2020.

**Keywords:** RRBs, Deposits, Advances, Profitability, Priority Sector and NPAs.

**INTRODUCTION**

“Rural India is Real India and Rural Development is the Real Development of India” opined Gandhiji. India is purely a rural populated country; nearly 65.53 per cent (89.53 crores) of the India’s population dwells in rural areas. So, the economic development of the country depends on the development of the rural economy. The Indian Government well recognized this fact and instigated many

# Reinforcement Learning and Heuristic Algorithms for Efficient Routing Protocols in Mobile Ad-Hoc Networks: An Advanced Approach

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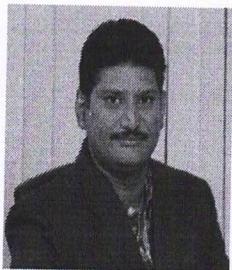
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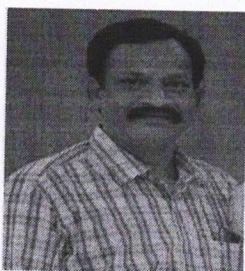
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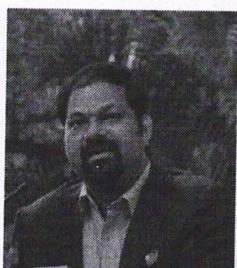
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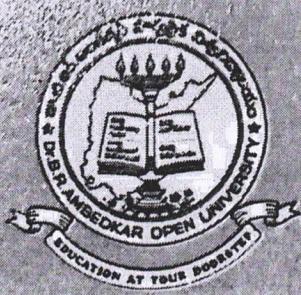
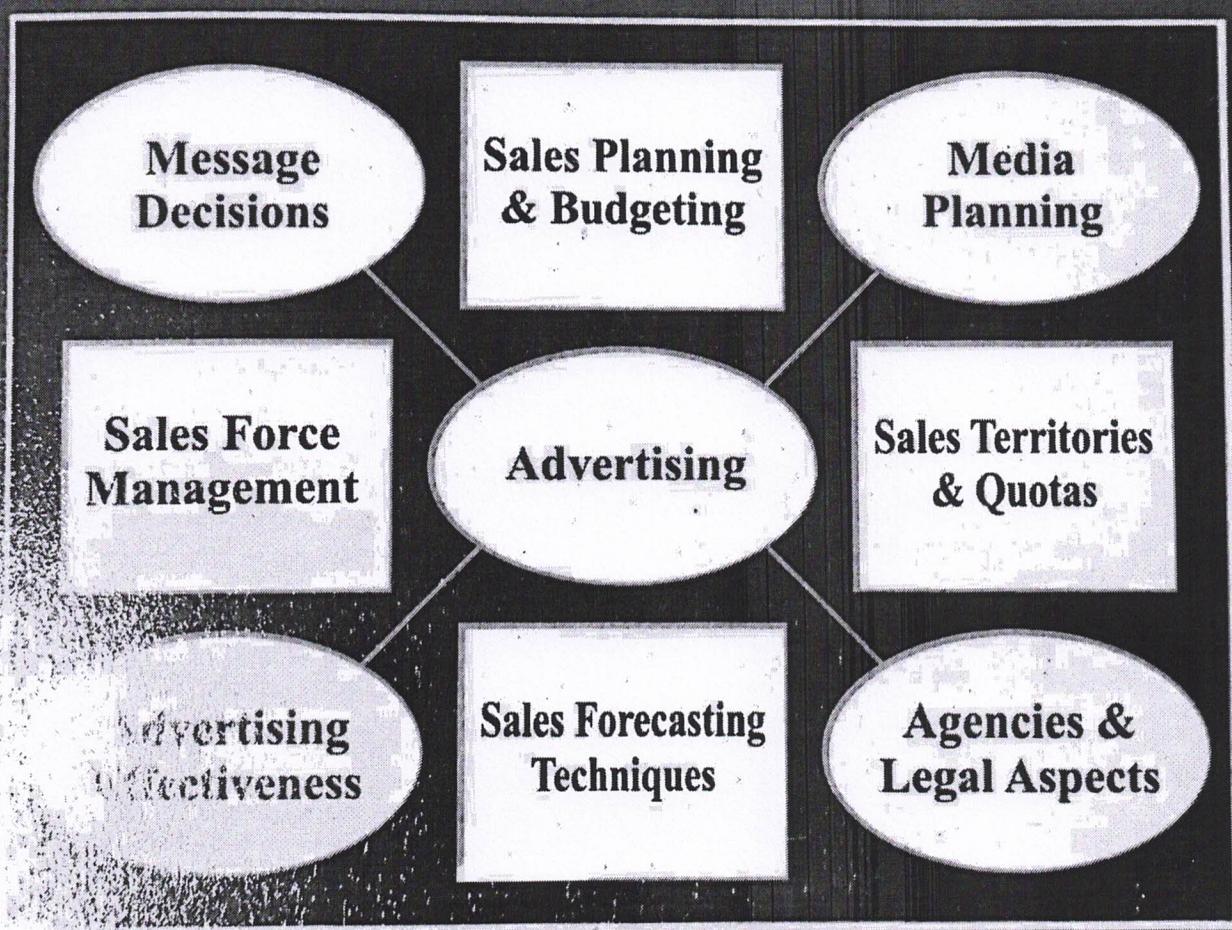
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**SECOND YEAR SEMESTER - IV**

**ADVERTISING AND SALES MANAGEMENT**



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# **UNIT - 13 : SALES PLANNING, BUDGETING AND CONTROL**

## **Objectives**

After studying this unit, you should be able to:

- understand the importance of sales planning;
- identify the types of sales planning;
- explain the process of sales planning;
- discuss the essentials of good sales forecasting, and
- examine the sales budgets and control.

## **Structure**

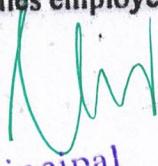
- 13.1 Introduction
- 13.2 Meaning of Sales Planning
- 13.3 Importance of Sales Planning
- 13.4 Types of Sales Planning
- 13.5 Factors Affecting Sales Planning
- 13.6 Stages in Sales Planning
- 13.7 Essentials of Sales Planning
- 13.8 Selling Strategies
- 13.9 Execution of Sales Plans
- 13.10 Challenges to Sales Planning
- 13.11 Sales Budgets and Control
- 13.12 Summary
- 13.13 Keywords
- 13.14 Model Examination Questions
- 13.15 Suggested Readings

## **13.1 INTRODUCTION**

Progress and prosperity of any organization, either business or non-business, directly depends on its planning activities. In sales management, sales planning is the primary activity and it has its own importance. Based on sales planning other activities of business are planned. In other words, it gives kick start to remaining functions like sales organization, selection, training and development of sales employees, allocation of resources, sales control, etc. In view of importance of the sales planning, it is proposed to study various concepts of sales planning in this chapter.

## **13.2 MEANING OF SALES PLANNING**

Planning means decide the future course of action in advance. This means deciding what we are going to do in the future, i.e., tomorrow, how and when we are going to do it. A sales plan is an evaluation of present sales of a product in particular market region. It includes sales objectives, strategies that are required to achieve the predetermined sales objectives and allocation of required resources. A sales plan of a firm also includes assignment of sales targets to sales employees in



### Objectives

After studying this unit, you should be able to:

- understand the meaning of sales territories and identify the procedure for developing sales territories;
- explain the process of managing sales territories;
- discuss the sales quota and targets, and
- examine the sales monitoring sales targets.

### Structure

- 14.1 Introduction
- 14.2 Meaning of Sales Territories
- 14.3 Scope of Sales Territory Management
- 14.4 Procedure for Developing Sales Territories
- 14.5 Managing Sales Territories
- 14.6 Sales Quotas and Targets
- 14.7 Monitoring Sales Targets and Revision
- 14.8 Summary
- 14.9 Keywords
- 14.10 Model Examination Questions
- 14.11 Suggested Readings

## 14.1 INTRODUCTION

Sales territory is the technique used by the sales manager to manage and control the sales force efficiently and effectively. It is very difficult for the sales manager to monitor huge market and selling activities by one. Hence, he (sales manager) divides it into territories to manage and control the sales force. A territory can be defined based on the geographical area, sales potential, history, or a combination of all these factors. It is the geographical area or areas assigned to sales person/persons to marketing the products of a company. Companies attempt to balance their territories because this can reduce selling and marketing costs and increase sales and revenue. In general, a firm splits the total market into some specific geographical areas and assigns each salesman a specific zone in which he has to carry out his selling operations. The geographical area assigned to a salesman becomes his sales territory. Each of the territory is served by one or more salesmen.

## 14.2 MEANING AND DEFINITION

A territory may or may not consist of geographical boundaries. It consists of present and potential customers of the product. Normally, a sales person is assigned to a geographic area of existing and potential customers. This territory is assigned to sales persons as their operating territory. They cannot go beyond this territory in ideal scenario. For example, a sales team is asked to look after Delhi customers. This sales team is responsible for the sales of Delhi city. The

## Objectives

After studying this unit, you should be able to:

- explain the importance of sales forecasting;
- identify the types of sales forecasting;
- discuss the methods of sales forecasting, and
- explain the essentials of good sales forecasting.

## Structure

- 15.1 Introduction
- 15.2 Meaning and Definition of Sales Forecasting
- 15.3 Importance of Sales Forecasting
- 15.4 Types of Sales Forecasting
- 15.5 Factors Affecting Sales Forecasting
- 15.6 Methods of Sales Forecasting
- 15.7 Characteristics of Good Sales Forecasting
- 15.8 Summary
- 15.9 Keywords
- 15.10 Model Examination Questions
- 15.11 Suggested Readings

## 15.1 INTRODUCTION

Sales are the primary source of revenue and increases cost of production of the firm. Since total production is to be sold out and practically nothing can be produced overnight. Hence estimation of future sales is needed to decide quantity of production for a given period. Production of goods requires combination of various resources (money, men, machines, methods and materials) which have to be employed properly. Thus, sales forecast is the most significant for future business plan. Sales forecast helps the firm to know the expected level of sales for its products and plan its production activities accordingly. Sales forecast plays an indicative role in the organization to all planning activities. Assuming indefinite continuation of status quo and expect no changes in future days seems impossible and unrealistic. So the firm has no chance to forecast or not to forecast. The only one choice is that the way the forecast is made, when it does, who does it and what resources are to be adopted for it. Accurate sales forecast is essential because plans of all functional areas depend on such forecast.

## 15.2 MEANING AND DEFINITION OF SALES FORECASTING

The term 'forecast' refers to prediction or estimation of future happening based on the present situation. For example weather forecast. Sales forecasting is not a mere speculative exercise. It is judgment of future probable changes in the market considering scientific principles. Sales forecasting is an estimation of future sales. It cannot be cent percent correct because future is uncertain. It is an activity, trying to estimate the future sales quantity of the firm. All individuals and organization engage in this activity, albeit at different levels of methodological complexity.

## Objectives

After studying this unit, you should be able to:

- understand the meaning of strategic sales plans;
- identify the stages in human needs;
- discuss the strategies in product life cycle;
- discuss the portfolio managements of a business firm, and
- explain the role of sales manager in the twenty first century.

## Structure

- 16.1 Introduction
- 16.2 Maslow's Hierarchy of Needs
- 16.3 Brand Functions
- 16.4 Product Related Analysis
- 16.5 Competitive Analysis
- 16.6 Strategic Marketing Process
- 16.7 Customers Analysis
- 16.8 Market Share Strategy
- 16.9 Product Life Cycle
- 16.10 Portfolio Management Analysis
- 16.11 Sales Manager for 21<sup>st</sup> Century
- 16.12 Critical Path to Continuous Success
- 16.13 Summary
- 16.14 Keywords
- 16.15 Model Examination Questions
- 16.16 Suggested Readings

## 16.1 INTRODUCTION

With the dynamic environment of the market, it is necessary to sales managers of a company to opt best choice from two. Managers either chose react to the situation or proactive, on which they should take initiative steps for planning and implementing their plans to maintain their sales and their market share and brand equity in the market. The present market is too dynamic to excuse the delay decisions of managers. The following reasons make the obligatory to the managers to prepare strategic plans for the organization:

1. Demand for timely decision due to constant changes in business environment.
2. To face real issues in the market.
3. To achieve long term targets of the organization.
4. Proper allocation of resources to avoid unfruitful results.
5. To establish appropriate communication and control system in the organization.

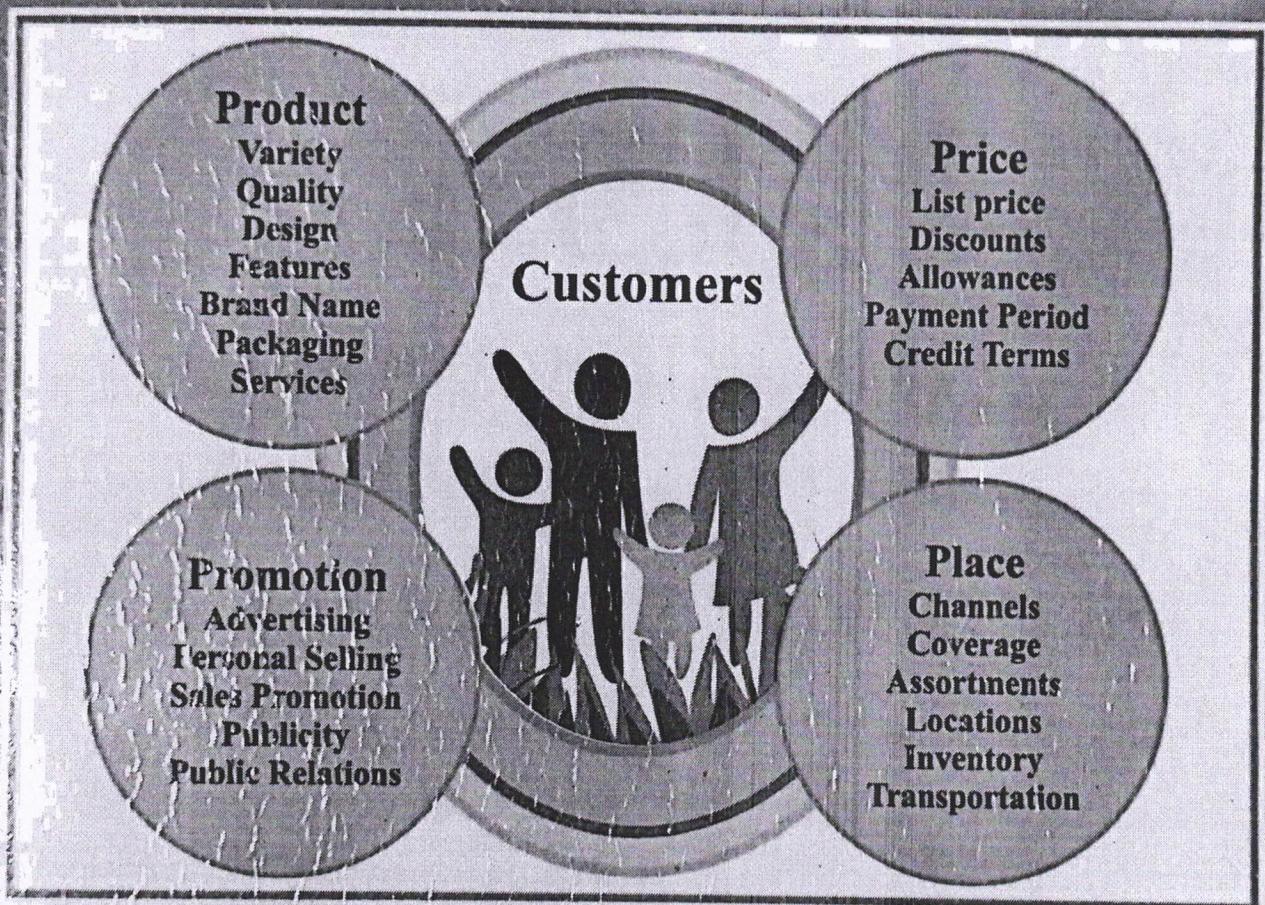
Strategic plans are required to launch new products, product variants at right time. Timing of the introduction is of strategic importance as wrong timing could meet the disastrous product

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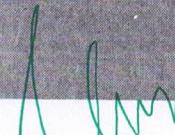
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## Multi-Quality Characteristics Optimization of NPMEDM of Nimonic 90 by Using Data Envelopment Analysis based Ranking Technique

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**Abstract** - In the manufacturing industry, to produce high-quality products at a reasonable cost, Optimization is a useful technique for determining the optimal production conditions. The focus of this research is to learn more about the influence of input parameters and determine the best settings for these variables to maximize MRR while decreasing SR and TWR while using Nimonic 90 NPEDM. The EDM characteristics of peak current, MWCNT powder, and nano Al powder were measured at three different levels using the L27 orthogonal array (OA). To improve the response parameters of material removal rate (MRR), surface roughness (SR), and tool wear rate, data envelopment analysis-based ranking method (DEAR) is widely used. The ideal values are achieved at MWCNT 0.5g/l, nano Al powder 2g/l, peak current 15 Amp, respectively, based on the findings of calculated Multi performance rank index (MRPI) values. MWCNT and peak current ( $I_p$ ) discovered to be the most effective important parameters impacting quality attributes based on the results of the ANOVA.

**Keywords**- NPMEDM, Data envelopment analysis based ranking technique, MWCNT powder, nano Al powder and Nimonic 90.

### I. INTRODUCTION

EDM is used to manufacture product surfaces in a variety of industries, including mould production, die making, and small hole drilling. [1,2]. This technique can increase electrical conductivity regardless of the mechanical properties of the material. It hardens electrical energy to a work piece submerged in a dielectric, causing plasma to form and sparks to erupt between the work material and the tool, melting and evaporating both the electrode tool and the work piece [3]. In EDM, the positive terminal is generally