Manoharbhai Shikshan Prasarak Mandal Armori's

MAHATMA GANDHI ARTS, SCIENCE &
LATE NASARUDDINBHAI PANJWANI COMMERCE
COLLEGE, ARMORI
Dist. Gadchiroli (Maharashtra) 441 208
Affiliated to Gondwana University, Gadchiroli.
Re-accredited by NAAC 'A' with 3.24 CGPA

ANNUAL QUALITY ASSURANCE REPORT

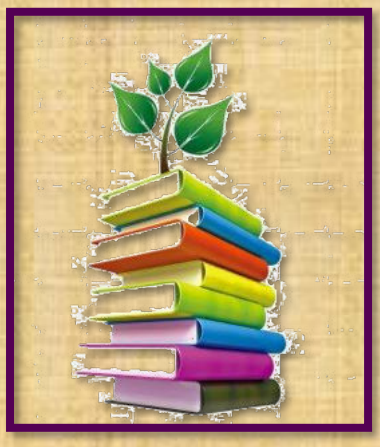
AQAR : 2023-2024

CRITERION – I

CURRICULAR ASPECTS

METRIC NO: ~ 1.3.3.

METRIC NAME: ~Number of students undertaking project work / field work/ internships.



Web: - mgcollegearmori.ac.in
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Project Work Reports/ Field Visit Reports of B.Sc.

MANOHARBHAI SHIKSHAN PRASARAK MANDAL ARMORI'S
MAHATMA GANDHI ARTS, SCIENCE &
LATE NASARUDDINBHAI PANJWANI COMMERCE COLLEGE
ARMORI Dist. Gadchiroli (M.S.) 441 208
Affiliated to Gondwana University, Gadchiroli
Re-accredited by NAAC 'A' with 3.24 CGPA (2022)
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Dr. Lalsingh H. Khalsa
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IQAC Coordinator
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Certificate of Verification

The document herewith is a testimonial of the following specifics;

- AQAR 2023-24
- Criterion - **I (Curricular Aspects)**
- Metric no. – **1.3.3**
- Metric Particular – **Number of students undertaking project work / field work/ internships.**

It is affirmed that the attached document pertinent to the above cited specifics are duly verified and approved by the IQAC.

Criterion Head

IQAC Coordinator

IQAC-Co-ordinator

IQAC Chairperson

PRINCIPAL
M.G. Arts, Science &
Late N.P. Commerce College
ARMORI, Dist. Gadchiroli

M.G. Arts, Science & Late N.P. Commerce College * Armori *

Mahatma Gandhi Arts, Science and Late N. P. Commerce College, Armori

Department of Botany

Kachargadh Darekasa

Study Tour Report

Academic Session 2023-24

Mahatma Gandhi Arts, Science and Late N. P. Commerce College, Armori

Department of Botany

Study Tour Report 2023-24

Date	Name	Event	Student strength
17/02/2024	Department of Botany	Study tour	25

As per academic syllabus of Gondwana University, Gadchiroli, the department of Botany organized one day study tour at Kachargadh Darekasa District Gondia on dated 17/02/2024.

Two members of the Department of Botany, Dr. S. T. Nagdeve and Dr. V. I. Kahalkar, along with 25 B.Sc. students of I, II and III years visited Kachargad forest in Dareksa district of Gondia on 17 February 2024. Started at 6 AM and we reached Kachargad Dareksa sharp at 10:30 am. Our students actively observed various plant species including medicinal plants. This trip added valuable experience to our knowledge. We started 3 kms trek to identify local trees, shrubs, herbs and important plants without disturbing the nature. In the afternoon, we reached Kachargad Cave, the largest cave in Asia after climbing for about 3 kms. The variety of flowers found in Kachargarh area kept us excited. The majority of the plants identified during trekked belonging to the Asteraceae, Acanthaceae, Anacardiaceae, Apocynaceae, Bignonanaiceae, Bombacaeae, Caesalpinaceae, Combretaceae, Euphorbiaceae, Fabaceae, Flindersiaceae, Hypoxidaceae, Malvaceae, Mimosaceae, Periplocaceae, Poaceae, Rhamnaceae, Rubiaceae, Rutaceae, Sapindaceae, Spotaceae, Tiliaceae, and Verbenaceae families. The botanical names of the plants is as fallows *Andrographis paniculate, Anogeissus latifolia, Bauhinia racemose, B. vahlii*, *Bombax ceiba, Bridelia retusa, Butea monosperma, B. superba, Cassia fistula, Celastrus paniculata, Chloroxylon swietenia, Combretum album, Curculigo orchioides, Cymbopogon martini, Demdrocalamus strictus, Dioscorea bulbifera, Elephantopus scaber, Glochidion zeylanicum, Grewia tiliifolia, Haldina cordifolia, Hemidesmus indicus, Hemigraphis latebrosa, Hyptis suaveolens, Kydia calycina, Lagerstroemia parviflora, Lannea coromandelica, Lantena camera, Madhuca longifolia, Mallotus philippensis, Mangifera indica, Molineria trichocarpa, Parthenium hysterophorus, Phyllanthus emblica, Pterocarpus marsupium, Schleichera oleosa, Sida acuta, S. cordifolia, Stereospermum chelenoides, Tectona grandis, Terminalia alata, Tephrosia purpurea, Tridax procumbens, Triumfetta rhomboidei, Tectona grandis, Ventilago denticulate, Vitex negundo* etc. families and plants species were found in Darekasa's Kachargarh Forest. After a long Nature walk through fascinating forests,

we took lunch and start journey towards Hazara fall and capture nice picture finally ended tour on Famous Manododevi Temple on way, where they shopped and spent some rest time. It was a great experience and fun for me.


Latitude: 21.20895
Longitude: 80.386568
Accuracy: 2300.0 m
Time: 02-17-2024 11:14
Note: Study tour


Latitude: 21.20895
Longitude: 80.386568
Accuracy: 2300.0 m
Time: 02-17-2024 11:17
Note: Study tour


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Note: Study tour


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Note: Study tour


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Note: Study tour


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Note: Study tour
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Time: 02-17-2024 15:33
Note: Study tour
Powered by NoteCam

Mahatma Gandhi Arts, Science & Late N. P. Commerce College, Armori
District Gadchiroli

Department of Botany

Study Tour

Place: Kachargadh Darekasa

Date: - 17-02-2024

Academic Session 2023-24

Sr. No.	Name of Students	Class	Signature
1	BAGMARE APURVA ASHOK	B. Sc. III	Apurva Bagmare
2	DHOTE MRUNALI WAMAN	B. Sc. III	
3	SARWE SHUBHANGI KALIDAS	B. Sc. III	
4	DHOTE PRAJAKTA KAVLU	B. Sc. III	
5	KULMETHE HARSHADA SURESH	B. Sc. II	H. Kulmethe
6	BORKAR PRIYANKA RAVINDRA	B. Sc. II	
7	TEMBHURNE AMIGHA VIJAY	B. Sc. II	A. V. Thembhurne
8	WARWADE VAISHNAVI DILIP	B. Sc. II	Warwade
9	HALDAR ANUJ SUDHANGSU	B. Sc. II	
10	DHOK SAKSHI AVINASH	B. Sc. II	
11	DHORE SALONI TIKARAM	B. Sc. II	
12	SHIURKAR KALYANI ANIL	B. Sc. II	
13	MHASHAKHETRI KRUTIKA VINAYAK	B. Sc. II	Krutika
14	NIKODE PUNAM GOWARDHAN	B. Sc. I	Nikode
15	NIKODE JANVHITAI KISHOR	B. Sc. I	
16	DHOTE ACHAL VILAS	B. Sc. I	Achal
17	SIDAM NIKITA VILAS	B. Sc. I	
18	KHANDARE MANISHA SUNIL	B. Sc. I	Manisha
19	HICHAMI HIRANAND DHARMA	B. Sc. I	
20	SAKHARE MANAV LOCHANKUMAR	B. Sc. I	
21	ZALKE BHUSHAN TIKARAM	B. Sc. I	
22	BHARADKAR RINA RAMESH	B. Sc. I	R. Bharadkar
23	THENGARI PORNIMA DEWRAO	B. Sc. I	P. Thengari
24	Sujata K. Sarwe	B.Sc.I	Sarwe
25	Tanmay Tulshidas Borkar	B. Sc. I	Tanmay
26			

HEAD
Dept. of Botany
M. G. College, Armori.

MAHATMA GANDHI ARTS, SCIENCE AND LATE N.P.
COMMERCE COLLEGE ARMORI DIST.
GADCHIROLI

SKILL ENHANCEMENT PROJECT REPORT

On

Survey Report on the Use of Fertilizers and Insecticides in Armori Area

Submitted By

Mr. Hemant Bansod

Group (Head)

Submitted To,

DEPARTMENT OF CHEMISTRY
MAHATMA GANDHI ARTS, SCIENCE AND LATE N.P. COMMERCE COLLEGE
ARMORI DIST. GADCHIROLI

CERTIFICATE

The project work entitled '**Survey Report on the Use of Fertilizers and Insecticides in Armori Area**' submitted by **Hemant Bansod (Group Head)** for the partial fulfillment of three years full-time graduation degree program has been carried out under the supervision of Dr. **Naresh D. Bansod** department of chemistry in Mahatma Gandhi Arts and Science & Late N.P. Commerce College Armori, Gondwana University, Gadchiroli. The work is compressive complete and fit for evaluation.

Dr. N. D. Bansod
Assistant Professor
Department of Chemistry

Prof. S. M. Sontakke
Head
Department of Chemistry

Head
Dept. of Chemistry
M.G. Arts, Science & Late N.P
Commerce College Armori

DECLARATION

I hereby declare that the project work entitled '**Survey Report on the Use of Fertilizers and Insecticides in Armori Area** submitted herein has been carried out by me in the **Department of Chemistry, Mahatma Gandhi Arts and Science & Late N. P. Commerce College Armori.** The work is original and has not been submitted earlier as a whole or in part for the award of a bachelor's degree in science.

The project work, submitted for the award of the degree of **"Survey Report on the Use of Fertilizers and Insecticides in Armori Area** is original and has not been submitted earlier as a whole or in part to any other university or institution for the award of any degree/diploma or certificate.

Mr. Hemant Bansod
Head

Date: 30 /04 /2024

Place: Armori

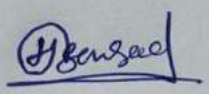
ACKNOWLEDGEMENT

We take this opportunity to express our profound gratitude and deep regard to our guide Dr. N. D. Bansod for their valuable guidance, monitoring, and constant encouragement throughout the course of this project. The blessings, help, and guidance he gives shall carry us in the journey of our life on which we are about to embark.

We are extremely thankful to Prof. S. M. Sontakke head department of chemistry and Dr. S. S. Kola fortheir timely help.

We also express a deep sense of gratitude to Dr. L.H. Khalsa principal of M.G. College for giving us this opportunity and for providing us with all the required facilities in the chemistry department.

Lastly, we thank almighty our parents and friends for their constant encouragement, without which the project would not be possible.



Hemant Bansod

Head

(Group)

Date: 30 /04 /2024

Place: Armori

SKILL ENHANCEMENT GROUP-A

Sr. No.	Students Name
1	Dhonadkar Pornima Rajendra
2	Mohurle Anuj Shamrao
3	Pilare Sneha Jaliram
4	Shrma Shrdha Ajay
5	Bansod Hemant Kishor
6	Bhoyar Vaibhav Chandu
7	Madavi Pratiksha Kishor
8	Sidam Divya Arun
9	Meshram Priynka Subhash
10	Dhodhe Rutuja Janardhan
11	Madavi Ajy Bhavesh
12	Chuke Harshada Ravindra
13	Jumnake Shruti Ramesh
14	Wakade Rohit Lomesh

Dr. N. D. Bansod
Assistant Professor
Department of Chemistry

Prof. S. M. Sontakke
Head
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Head
Dept. of Chemistry
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Commerce College Armori.

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Dr. N. D. Bansod
Assistant Professor
Department of Chemistry

Prof. S. M. Sontakke
Head
Department of Chemistry

Head
Dept. of Chemistry
M.G. Arts, Science & Late N.P
Commerce College Armori.

Skill Enhancement project

Summer 2024 B.Sc sem VI

S.N.	NAME OF STUDENT	GROUP	Marks P1(35)	Marks P2(35)
1	DONADKAR PORNIMA RAJENDRA	CHE, GEO, ZOO		
2	MOHURLE ANJU SHAMRAO	CHE, GEO, ZOO		
3	PILARE SNEHA JANIRAM	CHE, GEO, ZOO		
4	SHARMA SHRADDHA AJAY	CHE, GEO, ZOO		
5	BANSOD HEMANT KISHOR	CHE, GEO, ZOO		
6	BHOYAR VAIBHAV CHANDU	CHE, GEO, ZOO		
Ab 7	MADAWAR PRATIKSHA KISHOR	CHE, GEO, ZOO		
8	SIDAM DIVYA ARUN	CHE, GEO, ZOO		
9	MESHRAM PRIYANKA SUBHASH	CHE, GEO, ZOO		
10	DHOTE RUTUJA JANARDHAN	CHE, GEO, ZOO		
11	MADAVI AJAY BHAVESH	CHE, GEO, ZOO		
12	CHAUKE HARSHADA RAVINDRA	CHE, MB, ZOO		
13	JUMNAKE SHRUTI RAMESH	CHE, MB, ZOO	S.R. Jumnake	S.R. Jumnake
14	WAKADE ROHIT LOMESH	CHE, MB, ZOO		

Survey Report on the Use of Fertilizers and Insecticides in Armori Area

1. Introduction

This survey report is aimed at understanding the current practices related to the use of fertilizers and insecticides in the Armori area. Armori, a region known for its agricultural activities, relies heavily on the use of chemical inputs to boost crop production. This report highlights key findings related to the types of fertilizers and insecticides used, frequency of application, and the perceived benefits and challenges associated with these agricultural chemicals.

2. Methodology

The survey was conducted over a period of three months (from October to December 2024), involving interviews with 150 farmers across the Armori region. The participants were selected from different agricultural zones within the area, ensuring a representative sample of both small-scale and large-scale farmers. The survey employed both quantitative and qualitative methods, including structured questionnaires, personal interviews, and field observations.

3. Types of Fertilizers Used

The following are the primary types of fertilizers used in Armori:

- **Chemical Fertilizers**:
  - **Urea**: Predominantly used for boosting nitrogen levels, with 78% of farmers reporting regular use.
  - **DAP (Diammonium Phosphate)**: Widely used for phosphorus, with 65% of farmers employing it, particularly for crops like paddy and vegetables.
  - **MOP (Muriate of Potash)**: 48% of farmers use MOP, primarily for crops that require higher potassium content, such as sugarcane and groundnut.
- **Organic Fertilizers**:
  - While chemical fertilizers dominate, organic inputs like compost and manure are still in use, particularly by 22% of farmers practicing organic farming. However, the use of organic fertilizers is limited due to the higher labor and material costs involved.
- **Micronutrient Fertilizers**:
  - Zinc and boron-based fertilizers are used by 12% of farmers, especially for crops like soybean and cotton, where micronutrient deficiency is common.

4. Types of Insecticides Used

The survey identified several types of insecticides commonly used in the Armori area:

- **Synthetic Insecticides**:
  - **Chlorpyrifos**: The most commonly used insecticide, with 62% of respondents using it to control pests like termites, weevils, and root borers.
  - **Cypermethrin**: 45% of farmers reported using cypermethrin to control pests on vegetables and fruit crops.
  - **Imidacloprid**: 35% of farmers use Imidacloprid, particularly for crops like cotton and tobacco.
- **Biological or Natural Insecticides**:
  - A small proportion (15%) of farmers use biopesticides like neem-based products and Bacillus thuringiensis (Bt) to control pests in a more eco-friendly manner.
  - The preference for biological insecticides is growing, especially among organic farmers.

5. Application Patterns

- **Fertilizer Application**:
  - **Frequency**: 58% of farmers apply fertilizers 2-3 times per cropping season, typically at the time of planting, mid-season, and during flowering.
  - **Application Method**: The most common method is broadcasting (65%), followed by fertigation (22%) in irrigation systems and foliar spraying (13%).
  - **Dosage**: There is often inconsistency in the dosage of fertilizers used. While many farmers rely on expert recommendations, a significant number (35%) use fertilizers without following the prescribed dosage, leading to overuse in some cases.
- **Insecticide Application**:
  - **Frequency**: The majority of farmers (70%) apply insecticides 2-4 times per cropping season, with peaks during the early growth stages of crops.
  - **Application Method**: Most farmers use spray pumps (82%) for insecticide application, while a smaller group uses dusting equipment (12%).
  - **Concerns**: A common concern among farmers is the increasing resistance of pests to chemicals, with 40% of farmers reporting difficulties in managing pest populations with standard insecticides.

6. Perceived Benefits and Challenges

- **Benefits**:
  - **Improved Yields**: The most commonly reported benefit of fertilizer and insecticide use is improved crop yield (85% of respondents).
  - **Pest and Disease Control**: Insecticides help manage pest outbreaks, protecting crops from severe damage, which is particularly important for high-value crops like cotton, vegetables, and fruit crops (70% of respondents).
  - **Crop Quality**: Fertilizers and insecticides contribute to better crop quality, particularly in terms of size, color, and overall marketability (60%).
- **Challenges**:
  - **Soil Degradation**: A significant number of farmers (52%) are concerned about long-term soil health degradation due to the continuous use of chemical fertilizers.
  - **Resistance to Insecticides**: About 40% of farmers mentioned that pests are becoming resistant to common insecticides, leading to ineffective pest control.
  - **High Input Costs**: The cost of fertilizers and insecticides is a significant burden, especially for small-scale farmers. Many farmers (55%) report that rising input costs have impacted their profitability.
  - **Environmental Concerns**: There is growing awareness of the environmental impact, with 25% of farmers expressing concern over pesticide residues and contamination of water sources.

7. Recommendations

Based on the findings of the survey, the following recommendations are made:

1. **Promotion of Integrated Nutrient Management (INM)**: Encourage the balanced use of both organic and chemical fertilizers to maintain soil health and reduce dependence on synthetic fertilizers.
2. **Adoption of Integrated Pest Management (IPM)**: Promote IPM practices to reduce reliance on chemical insecticides and help control pest resistance. This includes encouraging the use of biopesticides and promoting crop rotation.
3. **Training and Education**: Provide regular training for farmers on the proper use of fertilizers and insecticides, focusing on optimal dosages, application techniques, and the benefits of using eco-friendly alternatives.
4. **Financial Support**: Government and private sector initiatives could offer subsidies or financial assistance to reduce the burden of high input costs on farmers, especially small-scale producers.

5. **Soil Health Initiatives**: Encourage the use of organic farming techniques and soil health programs to restore and maintain long-term soil fertility.

8. Conclusion

The use of fertilizers and insecticides is an essential part of agricultural practices in the Armori area, significantly contributing to increased crop yields and pest control. However, concerns over environmental sustainability, rising costs, and pest resistance need to be addressed. There is potential for improving practices through education, better resource management, and the adoption of sustainable farming techniques.

Mahatma Gandhi Arts, Science and Late Nasaruddhinbhai
Panjwani Commerce College,
Armori Dist. Gadchiroli(M.S.)

PROJECT FILE

Subject Name:- Computer Science

Topic Name:- Preventive Maintainance

Class:- B.SC. III Year (Sem VI)

Student Name:-

1. Vipin Nardesh Dongare
2. Anurag Anand Wasnik
3. Harshal Ravindra Chauke
4. Aditya Bhaskar Borkar

Guided by:-
Prop. Sunil D. Chute
(Head of Department)

Student Name & Topic Names

Preventive Maintainance

Sr. No.	Name of Student	Topic Name	HOD Sign
1	Vipin Nardesh Dongare	Introduction, Need, Tools, Materials, Procedures:Active hardware Maintainance , Active software Maintainance	
2	Anurag Anand Wasnik	Passive Maintainance procedure, Heat and Temperature Control, Dust and pollution control	
3	Harshal Ravindra Chauke	EMI Electrostatic Discharge Control, Humidity and corrosion control, Preventive maintainance schedule	
4	Aditya Bhaskar Borkar	BIOS and CMOS, Working with the BIOS Setup program	

Mahatma Gandhi Arts, Science and Late Nasaruddhinbhai
Panjwani Commerce College,
Armori Dist. Gadchiroli(M.S.)

PROJECT FILE

Subject Name:- Computer Science

Topic Name:- Preventive Maintainance

Class:- B.SC. III Year (Sem VI)

Sr. no.	Name of Student	Topic Name	Student signature
1	Vipin N. Dongare	Introduction, need, tools, materials, procedure: active hardware maintainance, active software maintainance	
2	Anurag A. wasnik	Passive software procedure, heat and temperature control, dust and pollution control	
3	Harshal R. Chauke	EMI Electrostatic discharge control, humidity and corrosion control, preventive maintainance schedule	
4	Aditya B. Borkar	BIOS and CMOS, Working with the BIOS setup program	

Guided by:-
Prop. Sunil D. Chute
(Head of Department)

Introduction to PC Maintenance:

PC maintenance refers to the regular upkeep and care of computer hardware and software components to ensure their proper functioning, longevity, and optimal performance. It encompasses a range of activities aimed at preventing hardware failures, software glitches, and security vulnerabilities.

Importance of PC Maintenance:

Regular maintenance is crucial for several reasons:

Optimal Performance: Over time, computers accumulate dust, heat, and software clutter, which can degrade performance. Regular maintenance tasks such as cleaning, defragmenting drives, and updating software help maintain optimal system performance.

Longevity: Proper maintenance can extend the lifespan of computer hardware. By addressing issues promptly and preventing avoidable damage, users can avoid premature hardware failures and costly replacements.

Data Security: Regular software updates and security patches are essential for protecting computers from malware, viruses, and other cyber threats. Neglecting updates can leave systems vulnerable to attacks and compromise sensitive data.

Cost Savings: Proactive maintenance is more cost-effective than reactive troubleshooting. By identifying and addressing potential issues early, users can avoid costly repairs or replacements down the line.

User Experience: A well-maintained computer provides a smoother and more enjoyable user experience. It reduces the likelihood of crashes, freezes, and slowdowns, enhancing productivity and satisfaction.

Overall, regular PC maintenance is essential for ensuring the smooth operation, longevity, and security of computer systems. By implementing a proactive maintenance routine, users can maximize the value and performance of their hardware and software investments.

Need for PC Maintenance:

Computer systems are complex devices comprised of various hardware and software components that require regular maintenance to ensure optimal performance and reliability. Failing to maintain computers properly can lead to several common issues and can result in costly repairs or replacements. Here's an in-depth look at the need for PC maintenance:

Common Issues Due to Lack of Maintenance:

Slow Performance: Over time, computers can accumulate temporary files, fragmented data, and unnecessary software, leading to sluggish performance. Without regular maintenance, these issues can worsen, causing slow boot times, program crashes, and overall system slowdowns.

Hardware Failures: Dust buildup and inadequate cooling can lead to overheating, which can damage internal components such as the CPU, GPU, and hard drives. Lack of maintenance can also result in worn-out fans, loose connections, and other hardware failures that impair system functionality.

Software Vulnerabilities: Outdated software, including operating systems, drivers, and applications, can contain security vulnerabilities that hackers can exploit to gain unauthorized access to systems or steal sensitive data. Without regular updates and patches, computers are at a higher risk of malware infections, ransomware attacks, and other cybersecurity threats.

Data Loss: Failure to back up important files and data regularly can result in permanent loss in the event of hardware failure, software corruption, or accidental deletion. Without proper backups, users risk losing valuable documents, photos, and other irreplaceable data.

Poor User Experience: A poorly maintained computer can lead to frustration and reduced productivity for users. Constant crashes, freezes, error messages, and other software issues disrupt workflow and hinder users' ability to perform tasks efficiently.

Cost-Effectiveness of Preventive Maintenance:

Preventive maintenance involves proactively addressing potential issues before they escalate into major problems. It is more cost-effective than reactive troubleshooting for several reasons:

Avoiding Downtime: Regular maintenance helps identify and resolve issues early, reducing the likelihood of sudden system failures or downtime that can disrupt business operations or productivity.

Reducing Repair Costs: By addressing minor issues promptly, preventive maintenance prevents them from escalating into costly repairs or hardware replacements. For example, cleaning dust from cooling fans can prevent overheating and prolong the lifespan of components.

Enhancing Longevity: Proper maintenance extends the lifespan of computer hardware, reducing the frequency of replacements and the associated costs. For businesses, this translates to lower total cost of ownership (TCO) over the lifecycle of IT assets

Improving Performance: Regular maintenance tasks such as disk defragmentation, software updates, and malware scans optimize system performance, allowing users to work more efficiently and reducing frustration caused by slow or malfunctioning computers.

In summary, the need for PC maintenance is evident in the common issues that arise from neglecting regular upkeep of computer systems. Preventive maintenance not only mitigates these issues but also offers cost-effective benefits compared to reactive troubleshooting, making it a wise investment for individuals and businesses alike.

Tools and Materials Required for PC Maintenance:

Proper maintenance of a computer system requires a set of essential tools and materials to perform various tasks effectively. Here's a detailed list along with the purpose of each tool/material and its usage in maintaining different components of a computer:

Screwdrivers:

Purpose: Screwdrivers are essential for opening computer cases, removing or securing screws on hardware components, and accessing internal parts.**Usage**: Different types and sizes of screwdrivers, such as Phillips head and flathead screwdrivers, are used to handle various screw types found in computers, including those securing CPU heatsinks, hard drives, and expansion cards.

Compressed Air:
Purpose: Compressed air is used to remove dust and debris from hard-to-reach areas inside the computer case without causing damage.
Usage: By blowing compressed air into vents, fans, and heatsinks, users can dislodge accumulated dust, preventing overheating and maintaining optimal airflow for cooling components.

Anti-Static Wrist Strap:
Purpose: An anti-static wrist strap helps discharge static electricity from the user's body, preventing damage to sensitive electronic components during handling.
Usage: Users wear the wrist strap while working inside the computer case to minimize the risk of electrostatic discharge (ESD) that could potentially damage internal hardware components.

Thermal Paste:
Purpose: Thermal paste (also known as thermal compound or thermal grease) facilitates efficient heat transfer between the CPU or GPU and their respective heatsinks.
Usage: When replacing or reseating a CPU or GPU heatsink, a thin layer of thermal paste is applied to the contact surface to fill microscopic imperfections and improve thermal conductivity, ensuring optimal cooling performance.

Cleaning Materials (Lint-Free Cloth, Isopropyl Alcohol):

Purpose: Lint-free cloths and isopropyl alcohol are used for cleaning various components, including screens, keyboards, and internal hardware.

Usage: The lint-free cloth, dampened with isopropyl alcohol, is ideal for wiping down surfaces, removing fingerprints, smudges, and dust without leaving behind residue or damaging sensitive components.

Cable Ties and Management Accessories:

Purpose: Cable ties and management accessories help organize and secure cables inside the computer case, improving airflow and aesthetics.

Usage: Users can use cable ties to bundle and route cables neatly, preventing tangling and interference with airflow, which promotes better cooling and easier maintenance.

Diagnostic Software and Tools:

Purpose: Diagnostic software and tools help identify hardware and software issues, troubleshoot problems, and perform system diagnostics.

Usage: Users can utilize diagnostic software to analyze hardware health, check for software conflicts or errors, and monitor system performance, facilitating proactive maintenance and troubleshooting.

By having these essential tools and materials readily available, users can perform routine maintenance tasks efficiently, prolonging the lifespan of their computer hardware and ensuring optimal performance and reliability.

Procedure

Active Hardware Maintenance:

Active hardware maintenance involves proactive measures to ensure the proper functioning and longevity of computer hardware components. It typically includes cleaning, inspection, and testing procedures to identify and address potential issues before they escalate. Here's a detailed outline of the steps involved in actively maintaining hardware components, along with guidelines for identifying and addressing common hardware issues proactively:

Cleaning:

Step 1: Power Off and Disconnect: Before starting any maintenance, shut down the computer and disconnect all power sources, including the power cord and battery (if applicable), to avoid electrical hazards.

Step 2: External Cleaning: Use a lint-free cloth dampened with isopropyl alcohol to clean the external surfaces of the computer, including the case, keyboard, and mouse. Remove dust, fingerprints, and other debris to maintain a clean and hygienic work environment.

Step 3: Internal Cleaning: Open the computer case using appropriate screwdrivers and compressed air to remove accumulated dust from internal components such as fans, heatsinks, and motherboard surfaces. Pay special attention to ventilation areas and ensure optimal airflow for cooling.

Step 4: Component Cleaning: Carefully remove and clean individual hardware components, such as RAM modules, expansion cards, and storage drives, using compressed air and lint-free cloths. Inspect for dust buildup, corrosion, or damage, and address any issues accordingly.

Step 5: Reassembly and Testing: Once cleaning is complete, reassemble the computer components, ensuring all connections are secure. Power on the computer and run diagnostic tests to verify hardware functionality and performance.

2. Inspection:

Step 1: Visual Inspection: Examine all hardware components for signs of wear, damage, or abnormalities, such as loose cables, bulging capacitors, or bent pins. Inspect connectors, ports, and sockets for corrosion or debris buildup that may affect connectivity.

Step 2: Temperature Monitoring: Use diagnostic software to monitor temperature readings from sensors embedded in hardware components, such as the CPU, GPU, and hard drives. Identify any components running at unusually high temperatures, which may indicate cooling issues or inadequate airflow.

Step 3: Performance Testing: Conduct performance tests, such as benchmarking or stress testing, to assess the stability and reliability of hardware components under load. Monitor for unexpected crashes, slowdowns, or errors that may indicate hardware issues requiring further investigation.

3. Identifying and Addressing Common Hardware Issues Proactively:

Overheating: Check for dust buildup in cooling fans and heatsinks, ensure proper airflow through ventilation areas, and consider upgrading cooling solutions if necessary.

Hardware Failure: Monitor system logs and diagnostic reports for signs of hardware failures, such as disk errors or memory faults. Replace faulty components promptly to prevent data loss or system instability.

Power Supply Issues: Test the power supply unit (PSU) for voltage irregularities or fluctuations using a multimeter. Replace the PSU if it shows signs of failure or instability to prevent damage to other components.

Connectivity Problems: Inspect cables, connectors, and ports for damage or loose connections. Replace defective cables or connectors and ensure proper seating to restore connectivity and prevent data loss.

By following these proactive maintenance procedures and guidelines, users can ensure the reliable operation and longevity of their computer hardware components while minimizing the risk of unexpected failures or downtime. Regular maintenance not only enhances system performance but also reduces the likelihood of costly repairs or replacements in the long run.

Active Software Maintenance:

Active software maintenance focuses on keeping the software components of a computer system up-to-date, secure, and optimized for performance. It involves regularly updating software, applying patches, and implementing security measures to ensure system stability and protect against vulnerabilities. Here's a detailed explanation of the importance of software updates, patches, and security measures, along with guidelines for installing updates, running antivirus scans, and optimizing software settings:

Importance of Software Updates, Patches, and Security Measures:

System Stability: Software updates and patches often include bug fixes, performance enhancements, and stability improvements that address issues identified in previous versions. By keeping software up-to-date, users can minimize crashes, errors, and compatibility issues, ensuring a stable computing experience.

Security: Cyber threats such as malware, viruses, ransomware, and phishing attacks pose significant risks to computer systems and data. Software updates and security patches frequently address known vulnerabilities and security loopholes, reducing the likelihood of exploitation by malicious actors and protecting against data breaches and cyberattacks.

Compatibility: New hardware technologies, software applications, and operating system features may require updates to ensure compatibility with existing systems and peripherals. By staying current with software updates, users can avoid compatibility issues and ensure seamless integration with other devices and software environments.

Performance Optimization: Software updates may include performance optimizations, resource management improvements, and efficiency enhancements that boost system responsiveness and speed up software execution. By optimizing software settings and configurations, users can further enhance performance and streamline workflow.

Process of Active Software Maintenance:

Installing Updates:

Operating System Updates: Regularly check for and install updates to the operating system (e.g., Windows, macOS, Linux) using built-in update mechanisms or software update tools. Set up automatic updates whenever possible to ensure timely installation of security patches and bug fixes.

Application Updates: Update third-party applications, such as web browsers, productivity suites, and media players, by checking for updates within each application or using centralized software management tools. Prioritize critical updates that address security vulnerabilities or performance issues.

Running Antivirus Scans:

Install and regularly update antivirus software to protect against malware, viruses, and other cyber threats. Schedule periodic full system scans to detect and remove malicious software and perform real-time scans to prevent malware from infecting the system.

Configure antivirus settings to enable automatic updates, scan schedules, and threat notifications. Customize scan preferences based on system usage patterns and security requirements.

Optimizing Software Settings:

Review and adjust software settings to optimize performance, enhance security, and customize user preferences. For example, adjust power management settings to balance performance and energy efficiency, configure firewall settings to block unauthorized access, and enable encryption for sensitive data.

Utilize performance monitoring tools and task managers to identify resource-intensive processes, background services, and startup programs that may impact system performance. Disable unnecessary startup items and background processes to free up system resources and improve responsiveness.

By implementing these active software maintenance practices, users can ensure the stability, security, and performance of their computer systems while minimizing the risk of software-related issues and vulnerabilities. Regular updates, patches, and security measures are essential components of a comprehensive maintenance strategy that protects against emerging threats and maintains the integrity of software ecosystems.

Passive Maintenance Procedures:

Passive maintenance procedures focus on preventive measures that require minimal intervention but contribute significantly to the overall health and longevity of computer systems. Here are some key passive maintenance techniques:

Cable Management:

Description: Organizing and securing cables inside the computer case to improve airflow, prevent tangling, and reduce the risk of tripping hazards.

Importance: Proper cable management enhances airflow, cooling efficiency, and aesthetics, reducing the accumulation of dust and preventing potential damage to cables and components.

Proper Ventilation:

Description: Ensuring adequate airflow and ventilation within the computer case by positioning components, fans, and vents strategically.

Importance: Proper ventilation prevents overheating of internal components, extends hardware lifespan, and maintains system stability and performance.

Ergonomic Setup:

Description: Arranging the computer workstation to promote user comfort, posture support, and ergonomic efficiency.

Importance: An ergonomic setup reduces the risk of repetitive strain injuries, musculoskeletal disorders, and discomfort associated with prolonged computer use, enhancing productivity and well-being.

Heat and Temperature Control:

Significance Managing heat and temperature levels in computer systems is crucial to prevent overheating, which can lead to component failure, reduced performance, and system instability. Excessive heat accelerates wear and tear on hardware components, shortens their lifespan, and increases the risk of thermal throttling or shutdowns.

Methods for Monitoring and Controlling Temperature:

1. Proper Airflow:

Description: Ensure adequate airflow within the computer case by positioning fans, vents, and components strategically to facilitate the intake and exhaust of cool air.

Importance: Proper airflow promotes effective cooling, dissipates heat generated by internal components, and prevents hotspots that can lead to thermal issues.

2. Cooling Systems:

Description: Install and maintain cooling systems such as CPU coolers, GPU coolers, case fans, and liquid cooling solutions to regulate temperature and dissipate heat efficiently.

Importance: Cooling systems help maintain optimal operating temperatures for hardware components, prevent overheating, and ensure system stability and longevity.

3. Thermal Management Software:

Description: Use software tools to monitor temperature readings from sensors embedded in hardware components, adjust fan speeds, and control system performance based on temperature thresholds.

Importance: Thermal management software provides real-time monitoring and control capabilities, allowing users to optimize cooling performance, mitigate thermal issues, and maintain hardware reliability.

Dust and Pollution Control:

Risks Associated: Accumulation of dust and pollutants inside computer systems poses several risks, including:

Overheating: Dust obstructs airflow, leading to inadequate cooling and increased temperatures within the computer case, which can cause components to overheat and fail prematurely.

Component Damage: Dust particles can settle on sensitive electronic components, causing short circuits, corrosion, and degradation of performance over time.

Reduced Performance: Dust buildup on cooling fans, heatsinks, and ventilation openings restricts airflow, causing components to work harder and resulting in decreased system performance and efficiency.

Fire Hazard: Accumulated dust is highly flammable and can pose a fire hazard if exposed to heat sources such as electrical components or sparks.

Prevention Strategies:

Regular Cleaning: Perform routine cleaning of computer components, including fans, heatsinks, vents, and internal surfaces, using compressed air, lint-free cloths, and cleaning solutions. This prevents dust buildup and ensures optimal airflow for cooling.

Use of Dust Filters: Install dust filters or dust-proof enclosures on intake and exhaust openings of computer cases to trap dust particles and prevent them from entering the system.

Maintaining a Clean Environment: Keep the area around the computer workstation clean and free from dust, smoke, and other pollutants that can enter the system and contribute to dust buildup. Regularly vacuum or dust the surrounding area to minimize airborne particles.

Proper Ventilation: Ensure proper ventilation of the computer workstation by positioning the system in a well-ventilated area with adequate airflow. Avoid placing the computer in enclosed spaces or near sources of dust and pollutants, such as smoking areas or dusty environments.

Preventative Maintenance Schedule: Establish a regular maintenance schedule to inspect and clean computer components at predetermined intervals, such as monthly or quarterly, to prevent dust buildup and maintain system reliability and performance.

EMI and Electrostatic Discharge Control:

Definition and Impact:

EMI (Electromagnetic Interference):

EMI refers to the electromagnetic radiation emitted by electronic devices or external sources, which can interfere with the operation of nearby electronic equipment, causing performance degradation or data corruption.

ESD (Electrostatic Discharge):

ESD occurs when static electricity builds up on surfaces or objects and discharges suddenly, potentially damaging sensitive electronic components such as CPUs, RAM modules, and integrated circuits.

Recommendations for Mitigation:

1. Proper Grounding: Ensure that computer systems and peripheral devices are properly grounded to dissipate static charges and provide a path for EMI to safely discharge. Use grounded power outlets and surge protectors to prevent ESD damage and protect against power surges.

2. Shielding: Install electromagnetic shielding components, such as conductive enclosures or ferrite cores, to block or attenuate EMI signals and prevent interference with sensitive electronics. Shielding materials can be applied to cables, connectors, and circuit boards to minimize EMI effects.

3.Handling Procedures: Implement proper ESD handling procedures, such as wearing antistatic wrist straps, using antistatic mats or workbenches, and grounding oneself before touching electronic components. Store sensitive components in antistatic bags or containers to prevent ESD damage during storage or transport.

4.Environmental Control: Maintain a controlled environment with stable humidity levels and minimal exposure to sources of EMI, such as power lines, radio transmitters, and magnetic fields. Position computer systems away from potential sources of interference and ensure proper ventilation to dissipate heat and reduce EMI effects.

5.Education and Training: Educate users and personnel on the importance of EMI and ESD prevention techniques and provide training on proper handling and installation procedures for electronic equipment. Promote awareness of EMI and ESD risks and encourage compliance with best practices to minimize the likelihood of damage or malfunctions.

Mahatma Gandhi Arts, Science and Late Nasaruddhinbhai
Panjwani Commerce College,
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PROJECT FILE

Subject Name:- Computer Science

Topic Name:- Study of Printers, Formatting and Troubleshooting

Class:- B.SC. III Year (Sem VI)

Student Name:-

1. Ashwini Rajendra Devikar
2. Aishwarya Manohar Akhade
3. Sweety Gundaru Alami
4. Rutuja Ghanshyam Deshmukh

Guided by:-
Prop. Sunil D. Chute
(Head of Department)

Student Name & Topic Names

Study of Printers, Formatting and Troubleshooting

Sr. No.	Name of Student	Topic Name	HOD Sign
1	Ashwini R. Devikar	Introduction to Features and Performance of Printers	
2	Aishwarya M. Akhade	Formatting	
3	Sweety G. Alami	Assembling and Disassembling of PC	
4	Rutuja G. Deshmukh	Troubleshooting	

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STUDY OF PRINTER, FORMATTING AND TROUBLESHOOTING

In this journey into the world of printers, we'll explore these key areas:
Printer: Unveiling the inner workings of printers, from inkjet to laser, understanding how they translate digital data into physical prints.
Formatting : Mastering the art of print formatting, ensuring your documents look polished and professional, from margins and fonts to layout and graphics.
Troubleshooting : Conquering common printer problems, diagnosing glitches and resolving printing issues, keeping your prints flowing smoothly.

Printer

A printer is a device that takes digital data from your computer and translates it into a physical copy, typically on paper. They're essential tools in homes, offices, and various businesses, allowing you to create hard copies of documents, reports, photos, and more.

Printer features :

Printer features can vary depending on the type of printer, but some of the most common ones include:
Print quality: This is measured in dots per inch (dpi) and refers to the sharpness and clarity of the printed text and images. Higher dpi means better quality.
Print speed: This is measured in pages per minute (ppm) and refers to how fast a printer can print a document.
Connectivity: Most modern printers offer USB connectivity, allowing you to connect your computer directly to the printer. Additionally, wireless connectivity options like Wi-Fi or Bluetooth can provide more convenience by allowing you to print from multiple devices, such as laptops, smartphones, and tablets, without the need for cables.
Multifunctionality: All-in-one printers offer printing, scanning, copying, and sometimes even faxing capabilities in a single device.
Automatic duplex printing: This feature allows you to print on both sides of the paper automatically, saving paper and reducing costs.
Paper handling: Consider the paper tray capacity and whether the printer can handle different paper sizes and types, such as cardstock or envelopes.

Printer Performance :

Printer performance is influenced by several factors, including:
Print speed: Measured in pages per minute (ppm), it determines how quickly a printer can produce a document.
Print resolution: Measured in dots per inch (dpi), it affects the sharpness and detail of printed text and images. Higher dpi translates to better quality prints.
Duty cycle: This refers to the recommended number of prints a printer can handle in a month. Exceeding the duty cycle can lead to overheating, malfunctions, and reduced lifespan.

Maintenance: Regular cleaning and replacing toner cartridges or ink cartridges can ensure optimal performance.
Processor speed and memory: Similar to computers, printers rely on processors and memory to handle print jobs. Faster processors and more memory enable smoother processing of complex tasks and faster printing.
Connectivity: The type of connection between your device and the printer can impact print speed. Wired USB connections generally offer faster and more stable data transfer compared to wireless connections like Wi-Fi.

Print Quality:
Print quality refers to the sharpness and clarity of the text and images reproduced on a printout. Several factors influence print quality, including:
Resolution: Measured in dots per inch (dpi), resolution determines how many ink droplets a printer can place in a single square inch. Higher dpi results in sharper and more detailed prints.
Printer type: Laser printers generally produce sharper text and handle complex graphics better than inkjet printers, which are more suited for printing photos.
Ink/toner quality: Using high-quality ink or toner cartridges can significantly improve print quality. Faded or low-quality cartridges can result in dull, streaky, or patchy prints.
Paper quality: The type of paper used can significantly impact print quality. For instance, thicker photo paper is better suited for printing photos, while everyday printing might use standard printer paper.
some additional factors that can influence print quality:
Calibration: Regularly calibrating your printer ensures that the colors being produced match the colors on your screen. This helps to avoid color casts or inaccurate color reproduction in your prints.
Image/file quality: The quality of the original image or file you're printing can also affect the final output. Low-resolution images might appear pixelated or blurry when printed, while high-resolution files will produce sharper and more detailed prints.

Print Speed;
Printer speed is typically measured in pages per minute (ppm) and refers to how fast a printer can print a document. Here's a breakdown of factors affecting printer speed:
Printer technology: Laser printers are generally faster than inkjet printers, especially for black and white printing.
Print mode: Printing in color is usually slower than black and white printing.
Print complexity: Documents with high-resolution images, complex graphics, or elaborate formatting will take longer to print than simple text documents.
Connection type: Wired USB connections typically offer faster and more stable data transfer compared to wireless connections like Wi-Fi.
Print resolution: Higher print resolution (dpi) translates to more detail and higher quality prints, but it also requires more time to produce each page.

increasingly common, especially for newer models. If this doesn't happen automatically, you can try manually adding the printer through your computer's settings.

Cleaning a Printer:
Here's a guide on cleaning a printer:
Safety Precautions:
Always turn off the printer and unplug it from the power source before cleaning.
Avoid using compressed air on laser printers, as it can damage the delicate laser toner cartridge.
Cleaning Materials:
Soft, lint-free cloths (microfiber cloths are ideal)
Isopropyl alcohol (rubbing alcohol) – optional
Cotton swabs (optional)
Cleaning Steps:
Exterior Cleaning: Wipe down the printer's exterior with a damp cloth to remove dust and debris.
Paper Tray: Remove any paper scraps or debris from the paper tray. You can also use a damp cloth to wipe the inside of the tray.
Print Cartridges (Inkjet Printers):
Consult your printer's manual for specific instructions on how to remove and clean the cartridges.
Typically, you can dampen a cotton swab with a small amount of isopropyl alcohol and gently wipe the printhead nozzles on the cartridge.
Avoid touching the nozzles with your fingers.
4. Print Head (For Both Inkjet and Laser Printers):
Some printers offer an automatic print head cleaning function. Refer to your printer's manual to see if this option is available and how to use it.
If not, you might find cleaning instructions for manually cleaning the print head in the manual. This process may involve using cotton swabs dampened with water or isopropyl alcohol.
5. Printer Rollers (For Both Inkjet and Laser Printers):
Locate the printer rollers (usually found near the paper tray) and gently wipe them with a damp cloth to remove any dust or debris that might cause paper jams.
Drying:
Allow all components to dry completely before reassembling the printer and plugging it back in.

Common Printer Problems:
Here are some of the most common printer problems you might encounter:
Paper Jams: Paper jams are a frequent issue arising from improper paper loading, mismatched paper sizes, or dusty printer rollers.
Print Quality Issues: Faded or streaky prints can result from low ink/toner levels, dirty print heads, or incorrect printer settings.

Printer Offline: Disconnected cables, network malfunctions, or incorrect printer settings can cause the printer to appear offline.
Slow Printing Speed: Several factors can slow down printing, including slow processor speed, complex print jobs, or using a wireless connection instead of USB.
Nothing Printing: Ensure the printer is turned on and properly connected, and check the print queue for any errors.

Formatting

Formatting refers to the way information is presented and arranged on a page or screen. It influences the visual appearance and readability of a document, presentation, or website. Here are some common aspects of formatting:
* Font: This refers to the typeface used for displaying text. Factors like font style (e.g., Times New Roman, Arial), size, and weight (bold, italic) all contribute to formatting.
* Alignment: This refers to the horizontal positioning of text on a page. Common alignments include left-aligned, right-aligned, centered, and justified.
* Spacing: Spacing includes line spacing (between lines of text) and paragraph spacing (between paragraphs). Proper spacing improves readability.
* Margins: The margins are the blank spaces around the edges of a page. Adjusting margins can create a balanced layout.
* Color: Color plays a significant role in formatting, used for text, backgrounds, or visual elements. Strategic color use enhances visual appeal and clarity.

Formatting PC:

Formatting a PC typically refers to the process of erasing all data from a storage drive and reinstalling the operating system. This can be done for various reasons, such as:
Selling or donating an old computer: Formatting ensures sensitive data is wiped clean before passing the device to someone else.
Troubleshooting software issues: A clean format can sometimes resolve persistent software problems or glitches.
Installing a new operating system: Formatting is usually necessary before installing a fresh copy of Windows or another operating system.
There are two main approaches to formatting a PC:
Using the built-in recovery tools: Modern Windows operating systems typically come with built-in recovery tools that allow you to reset the PC and erase all data.
Formatting the drive during OS installation: If you're reinstalling the operating system, you'll usually have the option to format the drive during the installation process.
Formatting permanently deletes all data on the drive. Back up any important files before proceeding.

Backup of Data before formatting:

Backing up your data is crucial before formatting your PC's storage drive. Formatting wipes all information on the drive, so having a backup ensures you don't lose important files. Here's how to create a backup:

External Hard Drive:

Connect an external hard drive with enough storage space to hold your important files.
Navigate your computer's file explorer (Windows) or Finder (Mac).
Locate the folders containing the files you want to back up. This could include documents, photos, videos, music, etc.
Right-click and select "Copy" or "Cut" depending on whether you want to keep the files on your PC or remove them after copying.
Navigate to your external hard drive and right-click, selecting "Paste" to transfer the files.

Cloud Storage:

Choose a cloud storage service like Google Drive, Dropbox, or OneDrive that offers sufficient storage for your needs. Create an account if you don't have one already.
Upload your important files to the cloud storage platform using their software or web interface.
Verify that the files have uploaded successfully by logging into your cloud storage account from another device and accessing your uploaded files.

System Restore:

System restore functionality is available on various operating systems, allowing you to revert system files and settings to a previous state. This can be helpful for troubleshooting software issues.
Here's a breakdown of the concept:
Creating Restore Points: The system creates restore points automatically at specific intervals or when significant changes occur, like installing software. You might also have the option to create manual restore points.
Restoring System State: When you initiate a system restore, the system files and settings are essentially reverted to their state at the chosen restore point. This undoes recent modifications to system files, programs, drivers, and configurations.
Preserving Personal Data: System restore typically doesn't affect personal files like documents, photos, or music. These files are usually stored separately and aren't overwritten during the process.
System restore can be a valuable tool for troubleshooting software problems on various operating systems without affecting your personal data. Be sure to consult your specific operating system's documentation for detailed instructions on using its system restore feature.

Precautions for Formatting:

Here are some crucial precautions to take before formatting your storage drive:
Backup Essential Data: Formatting permanently erases all information on the drive. Create a backup of all important files like documents, photos, videos, and music. You can use an external hard drive or cloud storage for backups.

Verify Backups: Once you've backed up your files, double-check to ensure they are accessible and complete on your chosen storage device.
Understand Formatting Options: There might be different formatting options available depending on your operating system. Be familiar with the specific formatting process you'll be using to avoid errors.
Choose the Right Drive: Make absolutely certain you're formatting the correct drive, especially if you have multiple storage drives in your system. Formatting the wrong drive can lead to significant data loss.
Beware of Data Recovery Limitations: While data recovery software exists, it isn't guaranteed to work after formatting. It's best to rely on a proper backup to ensure you don't lose irreplaceable files.

Troubleshooting

Troubleshooting is the methodical process of identifying and resolving problems in a system. It's like detective work for your devices or software, where you gather clues to pinpoint the root cause of the issue and then implement a solution to fix it.
Here's a simplified breakdown of the troubleshooting process:
Identify the problem: Clearly define the issue you're facing. What isn't working as expected? Specific details are key!
Gather information: Once you know the problem, try to collect relevant details. Are there error messages? Did you make any recent changes? What seems to trigger the issue?
Isolate the cause: Now comes some detective work! Can you test different components or disable unnecessary software to narrow down the culprit?
Implement solutions: Based on your findings, try potential fixes. This could involve restarting, updating software, applying patches, or even replacing faulty hardware.
Test and verify: After trying a solution, test the system thoroughly to see if the problem is truly resolved. If not, it's back to the drawing board.

Diagnostic and Repair Tools:
Diagnostic tools are essential allies for troubleshooting and repairing various electronic devices, including printers. They come in two main categories: software and hardware.
Diagnostic Software Tools:
These programs run on your computer and interact with the printer to identify and analyze potential issues. They're often the first line of defense in troubleshooting. Here are some common types:
Operating System Built-in Tools: Most operating systems, like Windows and macOS, have built-in printer troubleshooting tools. These can help diagnose basic connectivity issues and offer solutions.
Printer Manufacturer Software: Many printer manufacturers offer diagnostic software designed specifically for their devices. These tools can provide more in-depth analysis and may even suggest automated fixes.

Third-party Diagnostic Tools: Several third-party developers offer diagnostic tools that can work with various printer models. These tools can be particularly useful if you have a multi-brand printer setup.

Diagnostic Hardware Tools:

These are physical tools you use directly with the printer to assess its hardware functionality. They're typically used by technicians or for more complex troubleshooting scenarios. Here are some examples:

Multimeter: This versatile tool measures voltage, current, and resistance, allowing technicians to check electrical components within the printer.

Print Head Cleaning Kit: These kits contain cleaning supplies and instructions specifically designed to clean print heads, which can resolve issues like clogged nozzles and streaky prints.

Toner Cartridge/Ink Cartridge Tester: These tools can help determine if a toner or ink cartridge is faulty and needs replacement.

By combining software and hardware tools, technicians can effectively diagnose a wider range of printer problems and determine the most appropriate repair solutions.

Assembling and Disassembling PC:

Assembling and disassembling a PC can be a rewarding experience, allowing you to customize your machine and troubleshoot potential issues. Here's a simplified overview of the processes:

Assembling a PC:

Preparation: Gather your components (CPU, motherboard, RAM, storage drives, graphics card, power supply, case) and consult your motherboard's manual for specific assembly instructions.

Install the CPU: Carefully place the CPU into the designated socket on the motherboard, ensuring proper alignment. Secure the CPU cooler as instructed in the manual.

Install RAM: Locate the RAM slots on the motherboard and gently insert the RAM modules according to the manual's guidelines, typically in pairs for dual-channel configuration.

Mount the Motherboard: Secure the motherboard onto the case using the provided screws and standoffs.

Install Storage Drives: Mount your storage drives (HDD/SSD) into the designated drive bays within the case and connect them to the motherboard using SATA cables and power connectors.

Install Other Components: If using a dedicated graphics card, install it into the PCIe slot on the motherboard. Connect other peripherals like fans and front panel connectors following the manual's instructions.

Connect the Power Supply: Install the power supply unit (PSU) into the designated location within the case and connect its cables to the motherboard, CPU, storage drives, and other components according to the pin configurations.

Cable Management: Organize and neatly arrange the cables within the case to improve airflow and aesthetics. Use zip ties or cable management solutions if available in your case.

Close the Case and Connect Peripherals: Once everything is securely in place, carefully close the case and connect your monitor, keyboard, mouse, and other external devices.

Boot Up and Install OS: Connect your PC to the power outlet and turn it on. The system should POST (Power-On Self Test) and display a boot screen. You can then proceed with installing your operating system of choice.

Disassembling a PC:

Power Down and Disconnect: Always power down and unplug your PC from the mains before disassembling. Disconnect all external peripherals as well.

Remove the Case Panels: Following your case's design, remove the side panels to gain access to the internal components.

Graphics Card (if applicable): If you have a dedicated graphics card, carefully remove it from the PCIe slot by pressing the release latch and gently pulling it out.

Disconnect Storage Drives: Disconnect the SATA data and power cables from your storage drives (HDD/SSD).

Disconnect Other Components: Disconnect any additional components like front panel connectors and fan cables from the motherboard.

Unscrew the Motherboard: Remove the screws holding the motherboard in place and carefully lift it out of the case.

Remove RAM and CPU: Gently remove the RAM modules from their slots and unlock the CPU cooler mechanism to take out the CPU.

Remove Power Supply: Unscrew the PSU mounting screws and disconnect its cables from all components. Then, remove the power supply unit itself.

Organize the Components: Once disassembled, place the components in separate anti-static bags or compartments to prevent damage during storage or transportation.

Troubleshooting Display Problems:

Here are some steps to troubleshoot common display problems:

Check connections: Make sure the video cable is securely plugged into both the monitor and the computer. Try a different cable if possible.

Restart devices: Turn off the monitor and computer, then turn them back on. This can sometimes resolve minor glitches.

Adjust settings: Check the brightness and contrast settings on your monitor and computer. You may also need to adjust the display resolution.

Update drivers: Outdated graphics drivers can sometimes cause display problems. Try updating your graphics drivers to the latest version.

Test with another device: If you have another monitor or computer, try connecting your device to see if the problem persists. This can help isolate the issue.

Memory Troubleshooting:

Mahatma Gandhi Arts, Science & Late N. P. Commerce College Armori. Dist. Gadchiroli (M.S.) 441208

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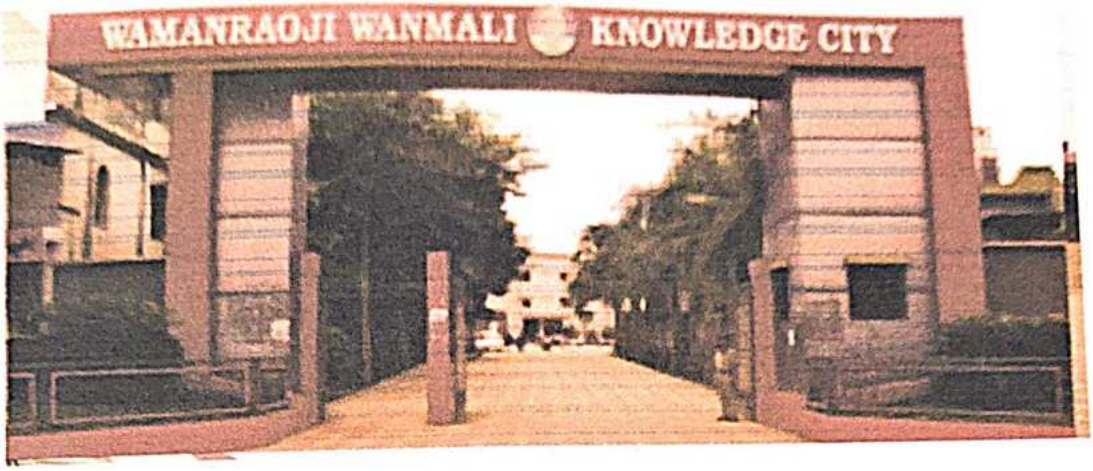

SKILL ENHANCEMENT COURSE
2023-2024

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TOPIC NAME- APPLICATION OF GEOLOGY IN MINING :A REVIEW

Guided By.

Dr. C. P. Dorlikar Sir (HOD)

Mahatma Gandhi Arts, Science & Late N. P. Commerce College, Armori.

2023-24

Certificate

This to certify that the Project Report entitled **APPLICATION OF GEOLOGY IN MINING :A REVIEW** submitted to the Department of Geology, Mahatma Gandhi Arts, Science & Late N. P. Commerce College, Armori. For the partial fulfilment of requirement of the B.Sc. (Geology) Semester V degree course embodies the results of bonafide work carried out

- **KARISHMA SAMRAO LOTHE**
- **ROHINI BHASHKAR UPARIKAR**
- **LISHA RAJENDRA DIWATE**
- VAISHALI BANDOPANT USENDI

Under my guidance.

Guided By.

Dr. C. P. Dorlikar Sir (HOD)

CERTIFICATE

`This is certified Karishma Samrao Lothe, Rohini Bhashkar Uparikar, Lisha Rajendra Diwate has carried out project work on

APPLICATION OF GEOLOGY IN MINING :A REVIEW Under the concern faculty supervision for the partial fulfillment of the B.Sc. they has carried out Project Work in the field and laboratories of the department of Geology, Mahatma Gandhi College Armori & Gondwana University Gadchiroli.

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Date:- 14/10/2023

Place: - Armori

Mahatma Gandhi Arts, Science & Late N. P. Commerce College, Armori ★ Department of Geology

Internal Examiner

Dr. C. P. Dorlikar

HEAD
Dept. of Geology
M. G. College Armori

ACKNOWLEDGEMENT

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Date:- 14/10/2023

Place: - Armori

KARISHMA SAMRAO LOTHE---K.Lothe---

ROHINI BHASHKAR UPARIKAR---Rohini---

LISHA RAJENDRA DIWATE---L.R.Diwate---

VAISHALI BANDOPANT USEND---Vaishali---

B.Sc. Geology SEM- VI

2023-2024

What is Geology

Geology is the study of the earth's crust and its rock formations, and includesclassifying and mapping of the composition and distribution of mineral depositscontained in the earth's formations. In the mining industry, this knowledge isapplied to find additional mineral resources and to upgrade existing resources.

Mining geology is an applied science which combines the principles of economic geology and mining engineering to the development of a defined mineral resource. Mining geologists and engineers work to develop an identified ore deposit to economically extract the ore.

Mines are inevitably depleted of their minerals. The miner has worked in the shadow of this fact throughout history. In the remains of the gold-silver workings at Cassandra in Greece there is evidence that miners dug in search of faulted vein segments at some time prior to 300 B.c. Their Athenian contemporaries, faced with the depletion of silver and lead ore at Laurium, recognized the favorability of marble near a schist contact and sank more than 1,000 shafts through barren rock, some to depths of 100m, in search of hidden orebodies. Geology, however primitive, was involved, but the science of mining geology was yet to be born-in the Saxon-Bohemian Erzgebirge, the mining profession's classic ground in Central Europe

MINING GEOLOGY'S PATRIARCH

During the sixteenth century, .Georgius Agricola, a physician of Chemnitz, Saxony, published several essays on prospecting, mining, and metallurgy that dominated geologic thought for two centuries. He was mining's own Renaissance Man with the particular Renaissance gift for description and analysis. In pe Re Metallica. Agricola (1556) presented the first comprehensive theory of epigenetic ore deposits, and he wrote about exploration in a way that favoured field observation far above what we now refer to as "signals from black boxes":

Surface Mining

Surface mining is done by removing (stripping) surface vegetation, dirt, and, if necessary, layers of bedrock in order to reach buried ore deposits. Techniques of surface mining include: open-pit mining, which is the recovery of materials from an open pit in the ground, quarrying or gathering building materials from an open-pit mine; strip mining, which consists of stripping surface layers off to reveal ore/seams underneath; and mountaintop removal, commonly associated with coal mining, which involves taking the top of a mountain off to reach ore deposits at depth. Most (but not all) placer deposits, because of their shallowly buried nature, are mined by surface methods. Finally, landfill mining involves sites where landfills are excavated and processed.

Open-Pit Mining

Open-pit mining, or open-cast mining is a surface mining technique of extracting rock or minerals from the earth by their removal from an open pit or borrow.

This form of mining differs from extractive methods that require tunneling into the earth, such as long wall mining. Open-pit mines are used when deposits of commercially useful minerals or rocks are found near the surface; that is, where the overburden (surface material covering the valuable deposit) is relatively thin or the material of interest is structurally unsuitable for tunneling (as would be the case for sand, cinder, and gravel). For minerals that occur deep below the surface—where the overburden is thick or the mineral occurs as veins in hard rock—underground mining methods extract the valued material.

Open-pit mines that produce building materials and dimension stone are commonly referred to as "quarries."

Open-pit mines are typically enlarged until either the mineral resource is exhausted, or an increasing ratio of overburden to ore makes further mining uneconomic. When this occurs, the

Phosphate

Underground Mining

The mantrip is yellow and resembles a train.

Sub-surface mining consists of digging tunnels or shafts into the earth to reach buried ore deposits. Ore, for processing, and waste rock, for disposal, are brought to the surface through the tunnels and shafts. Sub-surface mining can be classified by the type of access shafts used, the extraction method or the technique used to reach the mineral deposit. Drift mining utilizes horizontal access tunnels, slope mining uses diagonally sloping access shafts, and shaft mining utilizes vertical access shafts. Mining in hard and soft rock formations require different techniques.

Other methods include shrinkage stope mining, which is mining upward, creating a sloping underground room, long wall mining, which is grinding a long ore surface underground, and room and pillar mining, which is removing ore from rooms while leaving pillars in place to support the roof of the room. Room and pillar mining often leads to retreat mining, in which supporting pillars are removed as miners retreat, allowing the room to cave in, thereby loosening more ore. Additional sub-surface mining methods include hard rock mining, which is mining of hard rock (igneous, metamorphic or sedimentary) materials, bore hole mining, drift and fill mining, long hole slope mining, sub level caving, and block caving.

Machines

Heavy machinery is used in mining to explore and develop sites, to remove and stockpile overburden, to break and remove rocks of various hardness and toughness, to process the ore, and to carry out reclamation projects after the mine is closed. Bulldozers, drills, explosives and trucks are all necessary for excavating the land. In the case of placer mining, unconsolidated gravel, or alluvium, is fed into machinery consisting of a hopper and a shaking screen or

trommel which frees the desired minerals from the waste gravel. The minerals are then concentrated using sluices or jigs.

Large drills are used to sink shafts, excavate stopes, and obtain samples for analysis. Trams are used to transport miners, minerals and waste. Lifts carry miners into and out of mines, and move rock and ore out, and machinery in and out, of underground mines. Huge trucks, shovels and cranes are employed in surface mining to move large quantities of overburden and ore. Processing plants utilize large crushers, mills, reactors, roasters and other equipment to consolidate the mineral-rich material and extract the desired compounds and metals from the ore.

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Reaccredited by NAAC Bangalore with 'A' Grade CGPA - 3.24 (2022)

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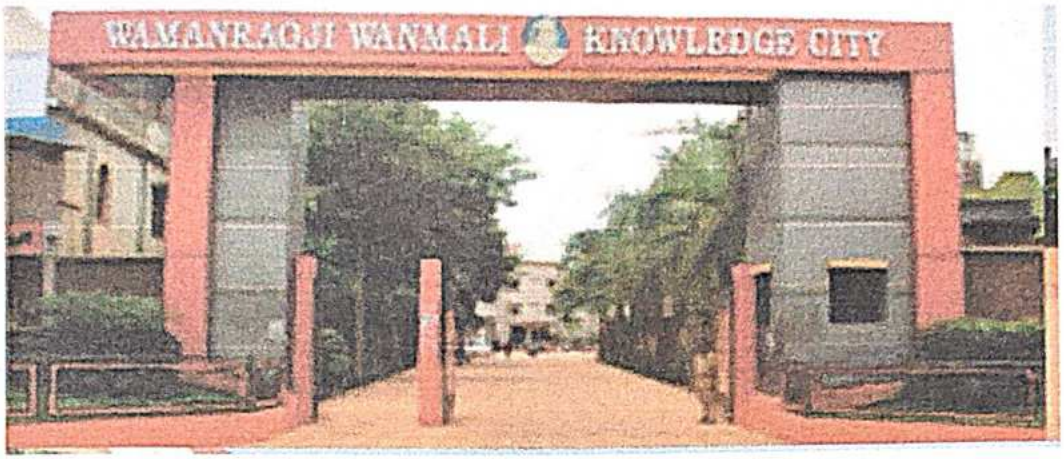

SKILL ENHANCEMENT COURSE
2023-2024

Name of the Student-

- Sejal Ashok Lade
- Sejal Darampal Barsagade
- Kalyani Suresh Meshram
- Vikas Dinalal Chawar

Class- B.Sc. Geology SEM -V

TOPIC NAME- APPLICATION OF GEOLOGY IN CIVIL ENGINEERING: A REVIEW

Guided By.

Dr. C. P. Dorlikar Sir (HOD)

Mahatma Gandhi Arts, Science & Late N. P. Commerce College, Armori.

2023-24

Certificate

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3. Kalyani Suresh Meshram----------
4. Vikas Dinalal Chawar----------

B.Sc. Geology SEM- VI

2023-2024

APPLICATION OF GEOLOGY IN CIVIL ENGINEERING: A REVIEW

INTRODUCTION

Geology provides a systematic knowledge of construction materials and their occurrence, formation, durability, strength, hardness and uses. Before starting any major/minor civil construction at a place, a detailed geological report which is accompanied by geological maps and sections is prepared. The detailed geological report contains types of rocks (Petrology), types of formations (geological structures) and physical properties of earth (Geophysics). Petrology is the study of rocks, where it provides rock hardness, chemical composition, strength, durability etc.

Petrology is particularly important as it gives the required load bearing properties of the rock which will help in deciding the usage. Sometimes there is a possibility of rocks of acceptable compressive strength being susceptible to chemical reactions, and may not be preferred for construction in certain fields Structural Geology is the study of patterns that are formed below the earth like folds, faults, joints and unconformity. Structural Geology is the necessary factor at present for major construction projects.

On account of the effects of these anomalies on the structures, there are few examples with negligible geological considerations which create loss to both life and property. In the recent years it has been noticed that more importance is given to the study of geological structures due to the past experiences. Geophysics is the study of physical properties and composition of the interior earth using gravity field, magnetic field and geothermal field. Modern geophysics methods that are used in civilengineering are mainly non-destructive testing. Equipment like geophones are employed to map the interiors of the earth crust by creating vibrations at a certain point and recording the same at a particular distance. Geophones use the concept of wave propagation to map the materials that may be present in the field. Geophysics is particularly important for shallow constructions where the underground amenities are not known.

ENGINEERING GEOLOGY IMPORTANCE:

Engineering geology provides a systematic knowledge of construction material, its occurrence, composition, durability, and other properties. Examples of such construction materials are

GEOLOGICAL CONSTRAINTS IN CIVIL ENGINEERING

The geology of an area dictates the location and nature of any civil engineering structures.

Roads and Railways Problems for a road or railway project may be caused by any of the following geological features:

- Faults
- Junctions between hard and soft formations
- Boundaries between porous and impermeable formations
- Spring-lines
- Fractured granites
- weathered schists2
- Landslip areas
- Areas where beds dip towards the road or railway, as shown in the adjacent Diagram.

IMPORTANCE OF PHYSICAL GEOLOGY

This is also variously described as dynamic geology, geomorphology, etc. As the name suggests it deals with:

- Different physical features of the earth, such as mountains, plateaus, valleys, rivers, lakes, glaciers, and volcanoes in terms of their origin and development,
- The different changes occurring on the earth's surface, like marine transgression, marine regression, formation or disappearance of rivers, springs and lakes,
- Geological work of wind, glaciers, rivers, oceans, ground water, and their role in constantly molding the earth's surface features, and
- Natural phenomena like landslides, earthquakes, and weathering. The main cause for surface changes is weathering. This is a natural phenomenon resulting directly or indirectly due to changes in the atmosphere. It disintegrates and decomposes rocks. This aspect is of special importance from the civil engineering point of view, because color, appearance, strength and durability of rocks are adversely affected by weathering. Thus even granite which is considered ideal for most of the civil engineering works becomes weak and friable on thorough weathering, rendering it useless. Civil engineers deal with

structures like dams which are artificial barriers to the natural flow of rivers. Proper understanding of the geological work of a river and its features will lead to their better utilization for engineering applications.

IMPORTANCE OF PETROLOGY

Petrology (Petro = rock, logos = study) deals with the study of rocks. The earth's crust, also called lithosphere, is made up of different petrology types of rocks. Petrology deals with mode of formation, structure, texture, composition, occurrence, types, etc., of rocks. The composition and textural characters of rocks primarily contribute to their inherent strength and durability. Rocks based on their suitability can be used as foundation for dams, for tunneling and materials of construction. Hence this is the most important branch of geology from the civil as engineering point of view.

IMPORTANCE OF STRUCTURAL GEOLOGY

Structural Geology the rocks which form the earth's crust undergo various deformations, dislocations and disturbances under the influence of tectonic forces. The result is the occurrence of different geological structures like folds, faults, joints and unconforimities in rocks. The details of mode of formation. Causes. Types, classification, importance, etc., of these geological structures form the subject matter of structural geology. From the civil engineering point of view, it is as important as petrology because these geological structures modify the inherent physical characters of rocks rendering them more suitable or unsuitable for civil engineering purposes. For example, at a dam site sedimentary rocks with upstream dip provide a desirable geological set-up, while the same rocks with downstream dip make the geological set-up most undesirable.

RELEVANCE OF GEOLOGY TO CIVIL ENGINEERING

Most civil engineering projects involve some excavation of soils and rocks, or involve loading the Earth by building on it. In some cases, the excavated rocks may be used as constructional material, and in others, rocks may form a major part of the finished product, such as a motorway cutting or the site f or a reservoir. The feasibility, the planning and design, the construction and costing, and the safety of a project may depend critically on the geological conditions where

APPLICATIONS OF GEOLOGY IN ENGINEERING CONSTRUCTIONS

1. Building Stones:

There are various kinds of rocks which have to be dressed and worked to shape for their utilization in constructions. Certain geological and physical properties must be satisfied for a good building stone. Durability, ease of transport and a pleasing appearance besides ease of quarrying process are some of the important properties required for building stones.

It is necessary to know the mineral composition of the building stone to determine its suitability and durability. Certain minerals like chert, pyrite, high mica content are harmful and injurious and rocks containing them are to be avoided. Presence of minerals such as pyrite which oxidises easily producing unsightly stains makes rocks undesirable. Coarse grained rocks are weaker than fine grained rocks.

2. Water Supply:

The sources of water supply are (i) surface waters from rivers and storage reservoirs (ii) underground waters from wells, deep borings and artesian wells. When rain falls on land it is dispersed partly by run off from the surface and partly by percolation into the ground. In moist temperate low lands it is estimated that one third of the rain fall collected constitutes the run off, one third sinks into the ground and the balance is lost by evaporation.

Sources of Ground Water:

Subsurface water is derived from a number of sources. In part, underground water is a direct contribution from magmatic or volcanic activity. In the process of crystallization water is excluded which moves into the adjacent rock to become part of the underground supply. Such water excluded in the crystallization of igneous rocks is called juvenile water or magmatic water. (Many ore deposits and mineral veins have been made by juvenile water).

Beneath the seas, the sediments deposited hold some water in the interstices. After some impervious sediments are deposited, some of this water may get imprisoned and retained in the sediments, until it is tapped. Water so trapped in sediments at the time of their deposition is called connate water. Salty water encountered locally in some inland wells is connate water.

The main source of subsurface water is a portion of the precipitation which sinks into the ground. This major portion of the ground water is called meteoric water.

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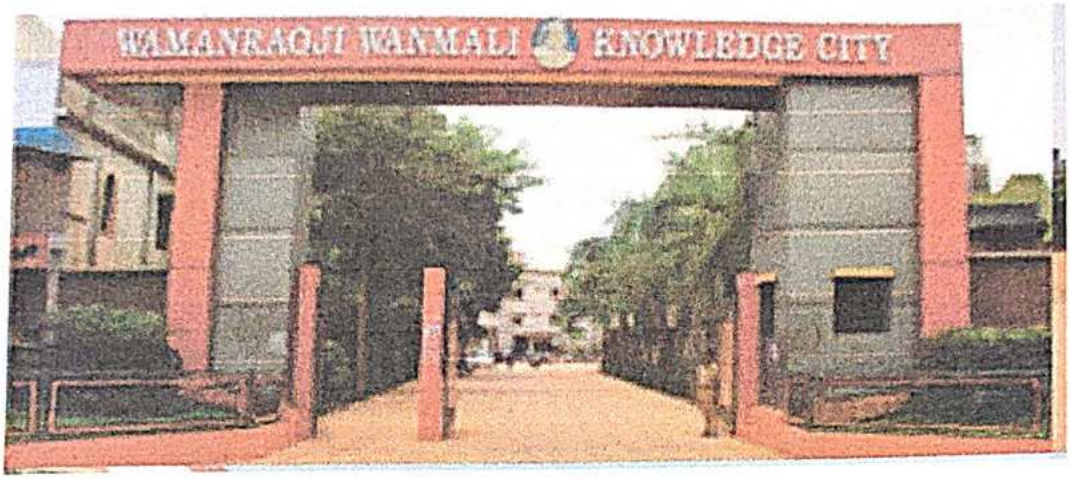

SKILL ENHANCEMENT COURSE
2023-2024

Name of the Student-

- Sejal Suresh Kambale
- Harshad Devidas Borkar
- Saloni Murlidhar Barsagade

Class- B.Sc. Geology SEM -V

TOPIC NAME- GEOLOGICAL PROSPECTING : AN OVERVIEW

Guided By.

Dr. C. P. Dorlikar Sir (HOD)

Mahatma Gandhi Arts, Science & Late N. P. Commerce College, Armori.

2023-24

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- Harshad Devidas Borkar----Borkar----
- Saloni Murlidhar Barsagade--Bhanaskar---

B.Sc. Geology SEM- VI

2023-2024

INTRODUCTION

Prospectors have made a tremendous contribution to the development of this Nation's mineral resources. Since the time of the earliest settlement, the need for iron for tools and guns, lead for bullets, and copper for utensils has prompted a search for sources of these metals. The lure of gold and silver provided the impetus for much of the development in the West between 1850 and 1910. Later, as the country's industrial demands for metals expanded to include zinc, molybdenum, tungsten, chromium, vanadium, and many others, these in turn were sought and found by prospectors. It is a mistake to suppose that uninhabited rugged mountains or desolate deserts have not been prospected; they probably have been. Nearly one-half billion tons of metallic ores, principally iron and copper, are mined annually in the United States.

Even greater amounts of ore must be found in the future to meet the Nation's increasing needs and to replace exhausted deposits. Because the easily found deposits have already been discovered, finding the new deposits will be difficult and will depend more and more on modern prospecting techniques.

PROSPECTING TECHNIQUES

- The prospector of today has advantages which to some extent make up for the increased difficulty of finding ore deposits. One of these advantages is a greatly increased knowledge about the geologic factors that have localized ore deposition. But the search for new deposits has become a complex undertaking, and the prospector should be as well informed as possible. He should acquire the ability to identify not only ore minerals, but also common rocks and their minerals, and he must be familiar with the main kinds of geologic structures. This knowledge is best acquired by academic training, but much can be obtained through use of such reference books as Lang (1956), von Bernewitz (1943), Walker (1955), and others listed at the end of this booklet. Geologic reports and geologic maps of areas of interest should also be studied. Topographic maps or air photographs of areas to be prospected should be obtained and used to plot sample locations and other appropriate data.
- A prospector can outfit himself in various ways according to his means and the

GEOLOGICAL PROSPECTING

- Many mineral deposits are not exposed at the earth's surface. They may either be concealed by thick soil cover, or they may lie buried beneath layers of rock. To find these deposits more complex techniques—based on geochemistry, geophysics, and geobotany can be very helpful. Most of these techniques require specialized training and, in some instances, expensive equipment.

- Geochemical prospecting is based on systematic measurement of one or more of the chemical properties of rock, soil, glacial debris, stream sediment, water, or plants. The chemical property most commonly measured is the content of a key "trace" element. The purpose is to discover zones in the soils or rocks that contain comparatively high concentrations of particular elements that will guide the prospector to a hidden deposit. Such concentrations of indicator elements in rocks or soils constitute a geochemical "anomaly". The actual amount of the key element in a sample may be very small and yet constitute an anomaly if it is high relative to the surrounding area. For example, if most samples of soil were found to contain about 0.00001 percent (0.1 part per million) silver, but a few contained as much as 0.0001 percent (1 part per million), the few "high" samples would be geochemical anomalies. Plots of analytical results on a map may indicate zones to be explored further.

- Geochemical anomalies are classified as primary or secondary. Primary anomalies result from outward dispersion of elements from mineral-forming solutions. The "high" concentrations of metals surround the deposit and the dispersion of metals laterally or vertically along fractures may result in a leakage "halo" that extends hundreds of feet away from the deposit. Halos of this type are especially useful in prospecting because they may he hundreds of times larger than the deposit they surround and hence are easier to locate.
- Secondary anomalies result from dispersion of elements by weathering. Some primary minerals, such as cassiterite, are resistant to chemical weathering and are transported by the streams as fragmental material.
- Other minerals may be dissolved and the metals may be either redeposited locally or carried away in solution in ground and surface waters. Some of the metal in solution may be taken up by plants and trees and can be concentrated in the living tissue. A great many studies have been made of the metal content of residual soils over sulfide deposits, and in general the distribution of anomalous amounts of metal in the soil has been found to correspond closely with the greatest concentration of metals in the underlying rock.

anomalies inherent in the rocks.

Radiometric Methods

- Naturally occurring radioactive elements such as uranium or thorium break down or decay to other elements or isotopes by emission of subatomic particles. Gamma rays (similar to X-rays but of higher frequency), alpha particles (nuclei of helium atoms), and beta particles (electrons) are the most common particles emitted during this process.
- The most important method in geophysical radiometrics is the measurement of gamma radiation. Gamma radiation is a high-energy electromagnetic radiation emitted during radioactive decay processes. Naturally occurring radioactive elements are Potassium, Uranium and Thorium. Gamma radiation emitted by their isotopes or daughter elements K-40 (Potassium), Bi-214 (Uranium) and Tl-208 (Thorium) shows a characteristic energy distribution for each isotope. By measuring the gamma energy spectrum the content of the three elements in the earth's surface layer can be determined.
- Radiometric measurements can be carried out from aircrafts (plane, helicopter or drone), on the ground (vehicle based or hand-held instruments) or in boreholes (borehole tool). The principle of measurement is almost the same for each of the setups. The detector is mostly comprised of one or more Sodium-Iodine crystals in which the energy of incoming gamma radiation is converted to light pulses and finally, by photo multiplier tubes, to electric pulses.

- The amplitude of the electric pulses is directly proportional to the energy of the incoming gamma rays. Depending on the energy level, the pulses are assigned to energy channels in a spectrum covering the range between 0 and 3 Mega-Electronvolts (MeV). If the whole system is calibrated it is possible to determine the associated concentrations of Potassium, Uranium and Thorium through an analysis of the spectra.

- In geophysical applications gamma ray spectrometers are mostly used for geological mapping, for mineral exploration, particularly Uranium exploration, and for environmental problems such as identification and mapping of radioactive contaminations. Due to a strong absorption of gamma rays by matter, only the signal of the upper about 50 cm of the Earth's surface is captured.

Indicator Plants

- Plants have been successfully used as aids in mineral prospecting, and under certain conditions may assist in locating buried mineral deposits. So many factors are involved, however, that it is not always possible to predict conditions under which plants will be of practical assistance.

Mahatma Gandhi Arts, Science and Late N. P. Commerce College, Armori

Department of Mathematics

SKILL ENHANCEMENT COURSE (SEC)

Project Work

Topic: Basics of Probability

Class: B.Sc. Sem-V

(Session 2023-24)

GROUP - A

1) Nikhil Narendra Gonnade

2) Khushi Mahendra Jambhulkar

3) Sonali Ramdas Tofa

R.A.K. 13/10/23

Mahatma Gandhi Arts, Science & Late N.P. Commerce College, Armori — Department of Mathematics

MAHATMA GANDHI ARTS, SCIENCE AND LATE N. P.

COMMERCE COLLEGE, ARMORI, DIST:GADCHIROLI

CERTIFICATE

This to certify that .....GROUP-A.....

1).....NIKHIL NARENDRA GONNADE

2).....KHUSHI MAHENDRA JAMBHULKAR

3).....SONALI RAMDAS TOFA

4).....

of class B.sc. sem-.....V..... (.....Win-23.....) has successfully completed his/her their project work on the topic.....BASICS OF PROBABILITY.....under the guidance of prof.....A. A. KHARWADE.....for the 'SKILL ENHANCEMENT COURSE' (Session 23-24.).

Head of the department

Prof. Dr. L. H. Khalsa

HEAD

Department of Mathematics

Mahatma Gandhi Arts,science

N.P.Commerce College,Armori

INDEX

SOME BASIC TERMS:

Random Experiment

A random experiment is a physical situation whose outcome cannot be predicted until it is observed.

Outcomes

The results of a random experiment are called its outcomes.

Sample Space

A sample space, is a set of all possible outcomes of a random experiment.

Example:

Random Experiment: Toss a fair coin once.

Sample Space: Ω ={Head, Tail}

Random Variables

A ***random variable***, is a variable whose possible values are numerical outcomes of a **random experiment**. There are two types of random variables.

1. ***Discrete Random Variable*** is one which may take on only a countable number of distinct values such

as 0,1,2,3,4,..... Discrete random variables are usually (but not necessarily) counts.

2. *Continuous Random Variable* is one which takes an infinite number of possible values. Continuous random variables are usually measurements.

SOME EXAMPLES

EXPRIMENTS	OUTCOMES	SAMPLE SPACE
TOSSING A COIN	HEAD, TAIL	S= {HEAD,TAIL}
TAING A TEST	PASS, FAIL	S= {PASS, FAIL}
PLAYING A GAME	WIN, LOSS, TIE	S= {WIN, LOSS, TIE}
ROLLING A DICE	1, 2, 3, 4, 5, 6	S= {1, 2, 3, 4, 5, 6}

Event

An event is a collection of one or more outcomes of an experiment. In other words, an event is a subset of the sample space. It is denoted by capital letters.

Ex. Consider a random experiment of tossing two coins simultaneously. S={ HH, HT, TH, TT}
Let A be an event of getting atleast one head.
Then A={ HH, HT, TH}
Clearly, A is a subset of the sample space S.

PROBABILITY:

Probability is the branch of mathematics concerning numerical description of how likely an event is to occur.

Definition

Let S be the sample space of a random experiment and let e be an event i.e. E ⊆ S.Then probability of an event E is denoted and defined as-

$$P(E)=\frac{NO\ OF\ FAVOURABLE\ OUTCOMES\ OF\ E}{TOTAL\ NO\ OF\ POSSIBLE\ OUTCOMES}=\frac{n(E)}{n(S)}$$

Ex. Let a dice is thrown randomly.

sample space, S={1, 2, 3, 4, 5, 6}

Let A be the event of getting an odd number.

So, A={1, 3, 5}

Then $P(A)=\frac{n(A)}{n(S)}=\frac{3}{6}=\frac{1}{2}$

i.e. there is 50% chance of occurring the event A of getting an odd number.

TYPES OF SINGLE EVENT

***1.Simple event*:** An event consisting of a single outcome of sample space s is called simple or an elementary event.Every sample point of the sample space s forms a simple event.

Ex. Let a coin is tossed, S = {H, T}

Let A be an event of getting only tail then A = {T} .

Here, A contains exactly one sample point and hence it is a simple event.

- The probability of a simple event is always $\frac{1}{n(S)}$.

***2.Sure event*:** An event which contains all the sample points of the sample space S is called as a sure event.

Ex. Let a card is drawn at a random from a pack of 52 cards.

Let A be an event getting either red or black card then clearly A is a sure event.

- The probability of a sure event is always 1.

***3.Impossible event*:** An event which does not contain any sample point of the sample space S is called as impossible event.

Ex. Let a die is thrown randomly ,S={1, 2, 3, 4, 5, 6}

Let A be an event of getting number greater than 6. Then A= Φ. Clearly, A is an impossible event.

- The probability of an impossible event is 0.

ALGEBRA OF EVENTS:

1. Union of two events: Let A and b be two events defind in a sample space S. Then union of events A and B is the collection of all outcomes belong to either A or b or both, it is denoted by A U B.

Ex. Let a die is thrown randomly ,S={1, 2, 3, 4, 5, 6}

Let A be an event of getting an odd number and B be an event of getting an even number.

Then A={1, 3, 5} and b={2, 4, 6}

So, A U B ={1, 2, 3, 4, 5, 6}.

- $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

2. Intersection of two events: Let A and B be two events defind in a sample space S. Then intersection of events A and B is the collection of all outcomes which are commom to both A and B, it is denoted by $A \cap B$.

Ex. Let a die is thrown randomly ,S={1, 2, 3, 4, 5, 6}

Let A be an event of getting a multiple of 3 and B be an event of getting an even number.

Then A = {3,6} and b = {2,4,6}.

So, $A \cap B = \{6\}$

3. Complementory events: Let A be an event defined in a sample space S. Then an event which contains outcomes of S other than in A is called complementory event to A, denoted by $\overline{A}$.

Ex. Let a coin is tossed, S={H, T}

Let A be an event of getting only tail then A={T} and B be an event of getting only head then B={H}.

Clearly, A and B are complementory events .

TYPES OF EVENTS BASED ON OCCURRENCE OF TWO EVENTS:

1.Independent events: If two or more events in a sample space occur in such a way that the occurence of one does not affect the occurrence of another then they are said to be independent events.

Ex. If a coin is tossed twice, the results of the second throw would be in no way affected by the results of the first throw, so the events in first toss and in second toss are independent to each other.

2.Dependent events: If two or more events in a sample space occur in such a way that the occurence of one affects the occurrence of another then they are said to be dependent events.

3.Equally likely events: Two events are said to be equally likely if they have the same probability of occurrence.

Ex. If a coin is tossed,S={H, T}.

Then events A of getting head and B of getting tail are equally likely events.

4.Mutually exclusive events: Two events A and B defined in a sample space S are said to be

mutually exclusive if they cannot occur simultaneously in a single trial ie. their intersection is empty.

Ex. Let a die is thrown randomly ,S={1, 2, 3, 4, 5, 6}

Let A be an event of getting an odd number and B be an event of getting an even number.

Then A={1, 3, 5} and b={2, 4, 6}.

Clearly, $A \cap B = \Phi$ and hence A and B are mutually exclusive events.

5.Mutually exhaustive events: Two events A and B defined in a sample space S are said to be mutually exhaustive if their combine outcomes make the sample space S i.e. $A \cup B = S$.

Ex. Let a die is thrown randomly ,S={1, 2, 3, 4, 5, 6}

Let A be an event of getting an odd number and B be an event of getting an even number.

Then A={1, 3, 5} and b={2, 4, 6}.

Clearly, $A \cup B = S$ and hence A and B are mutually exhaustive events.

NOTE: If two events A and B defined on the sample space S are mutually exclusive and mutually exhaustive then they are said to be complementory events.

PROPERTIES OF PROBABILITY:

Property 1. Probability of any event is always between 0 and 1.

i.e. If A is an event then then

$0 \leq P(A) \leq 1$

Property 2. The **sample space (S)** for a random variable represents all possible outcomes and must sum to 1 exactly.

i.e. $P(S) = 1$

Property 3. The probability of the **complement** of an event ("NOT the event")= 1 MINUS the probability of the event.

i.e. $P(\bar{A}) = 1 - P(A)$, $\bar{A}$ represents the complement of A

Property 4. Probabilities of **disjoint events** can be added. i.e. If A and B are disjoint then

$$P(A \text{ or } B) = P(A) + P(B)$$

Mahatma Gandhi Arts, Science and Late N. P. Commerce College, Armori

Department of Mathematics

SKILL ENHANCEMENT COURSE (SEC)

Project Work

Topic: Conditional Probability And Bayes' Theorem

Class: B.Sc. Sem-V

(Session 2023-24)

GROUP - B

1) Ankit Ravindra Satpute

2) Prachi Pandurang Meshram

3) Nikita Dilip Titirmare

R.AK. 13/10/23

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Head of the department

Prof. Dr. L. H. Khalsa

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Department of Mathematics

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Probability

The probability of any event is defined as 'The ratio of number of favourable outcomes for the occurrence of that event to the total number of distict possible outcomes of a random experiment'.

i.e. if S is the sample space of a random experiment and Let E be any event in S then

$$\text{probability of E} = \frac{\text{no of favourable outcomes}}{\text{no of all possible outcomes}}$$

$$= \frac{N(E)}{N(S)}$$

- Probability is the measure of the likehood of occurrence of an event.

Some basic properties:

1) If A' is the complement of event A then

$P(A')=1-P(A)$.

2) For any event A in sample space S, $0 \leq P(A) \leq 1$.

3) Probability of an impossible event is 0.

4) Probability of a sure event is 1.

5) If $A \leq B$ then $P(A) \leq P(B)$.

Conditional Probability

Let S be a sample space associated with the given random experiment. Let A and B be any two events defined on the sample space S. Then the probability of occurrence of A under the condition that event b has already occurred and $P(B) \neq 0$ is called the conditional probability of event A given b and is denoted by P(A/B).

Formula:

Let S be sample space associated with the random experiment and n(S) be the number of sample points in the sample space S. Since we are given that event B has already occurred, therefore our sample space reduces to event B only, which contains n(B) sample points. Now out of n(B) sample points, only $n(A \cap B)$ sample points are favourable for the occurrence of event A. Therefore, by definition of probability

$$P(A/B) = \frac{n(A \cap B)}{n(B)}, \; n(B) \neq 0.$$

$$= \frac{n(A \cap B)/n(S)}{n(B)/n(S)}$$

$$P(A/B) = \frac{P(A \cap B)}{P(B)}, \; P(B) \neq 0.$$

- Similarily, the conditional probability of event B given A is

$$P(B/A) = \frac{P(A \cap B)}{P(A)} \text{ , } P(A) \neq 0.$$

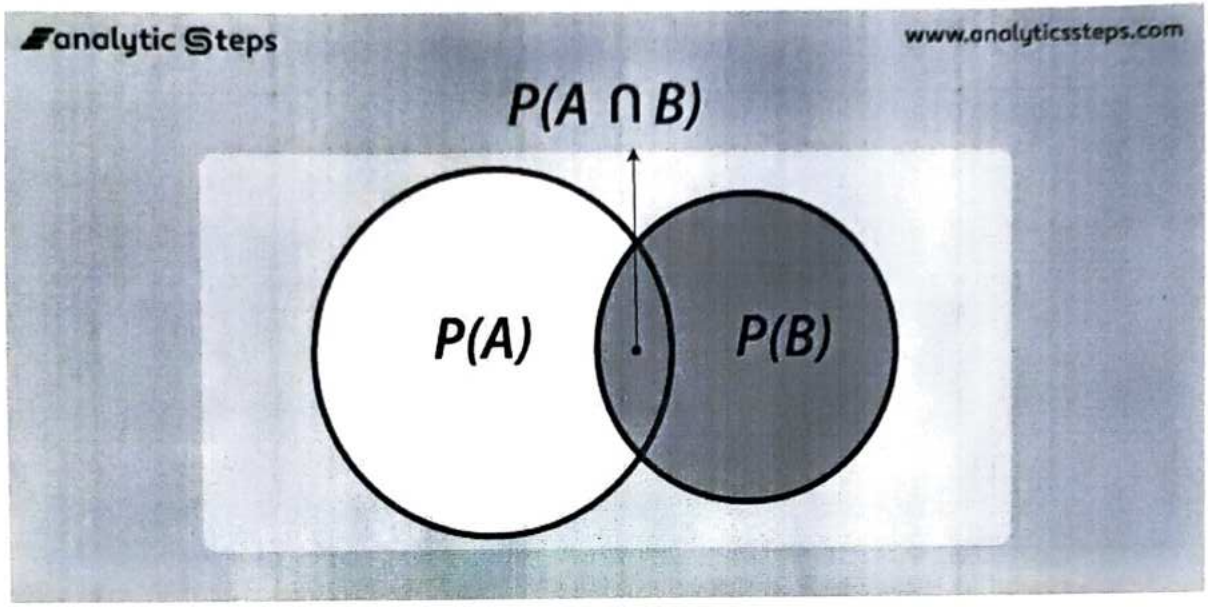


FIG. *Venn diagram for Conditional Probability, P(B|A)*

Ex. Find the probability that a single toss of a die will result in a number less than 4 if it is given that the toss resulted in an odd number.

Solution: Let a die is tossed, so $n(S)=6$.

Let event A: toss resulted in an odd number and event B: number is less than 4

$\therefore$ $A = \{1, 3, 5\}$, SO, $P(A) = 3/6 = 1/2$

$\therefore$ $B = \{1, 2, 3\}$

$\therefore$ $A \cap B = \{1, 3\}$ and $P(A \cap B) = 2/6 = 1/3$

Hence, required probability = P(number is less than 4 given that it is odd)

$$= P(B/A)$$

$$= \frac{P(A \cap B)}{P(A)}$$

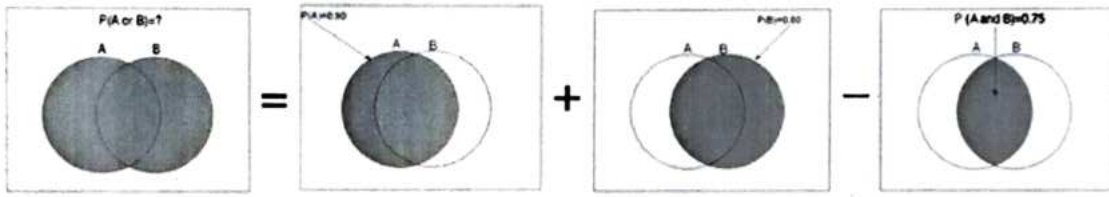
$$= \frac{1/3}{1/2}$$

$$= 2/3$$

Addition Theorem

Let S be a sample space associated with the given random experiment. Let A and B be any two events defined on the sample space S. Then the probability of occurrence of at least one event is denoted by P(A∪B) and is given by-

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$



We therefore get:

P(A or B) = P(A) + P(B) − P(A and B)

COROLLARY1: If two events A and B are mutually exclusive then-

$$P(A \cup B) = P(A) + P(B)$$

COROLLARY2: If A and A' are complementory events then-

$$P(A) + P(A') = 1.$$

Multiplication Theorem

Let S be a sample space associated with the given random experiment. Let A and B be any two events defined on the sample space S, Then the probability of occurrence of both the events is denoted by $P(A \cap B)$ and is given by-

$$P(A \cap B) = P(A).P(B/A)$$

$$= P(B).P(A/B)$$

Properties Of Conditional Probability

1. Let A and B be events of a sample space S of an experiment, then we have $\mathbf{P(A|B) = P(B|B) = 1}$.

2. If A and B are any two events of a sample space S and F is an event of S such that $P(F) \neq 0$, then-

$$\mathbf{P((A \cup B)|F) = P(A|F) + P(B|F) - P((A \cap B)|F).}$$

3. $P(A'|B) = 1 - P(A|B)$.

Independent Events

Let S be a sample space associated with the given random experiment, Lct A and B be any two events defined on the sample space S. If the occurrence of any one event does not depend on occurrence or non-occurrence of other event, then two events A and B are said to be independent.

Properties

1. If A and b are independent events then-

$P(A/B)=P(A)$ and $P(A/B)=P(B)$.

2. If A and b are independent events then-

$P(AB)=P(A).P(B)$

3. If A and b are independent events then

i) A and B' are also independent.

ii) A' and B' are also independent.

Baye's Theorem

Baye's theorem is a direct application of the conditional probabilities. It is used to determine prosterior probabailities.

STATEMENT: Let $E_1, E_2, \ldots, E_n$ be a set of events associated with a sample space S, where all the events $E_1, E_2, \ldots, E_n$ have nonzero probability of occurrence and they form a partition of S. Let A be any event associated with S, then according to Bayes theorem,

$$P(E_i \mid A) = \frac{P(A \cap E_i)}{P(A)} = \frac{P(E_i)P(A|E_i)}{\sum P(E_k)P(A|E_k)}, \text{for any } i = 1, 2, \ldots, n$$

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Department of Mathematics

SKILL ENHANCEMENT COURSE (SEC)

Project Work

Topic: Random Variables in Probability

Class: B.Sc. Sem-V

(Session 2023-24)

GROUP - C

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2) Jagruti Mohan Dunedar

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Head of the department

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Random variables

In probability

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Some basic definitions

- **Random variable:** A numerical quantity that takes on different values depending on chance.

- **Population:** The set of all possible values for a random variable.

- **Event:** An outcome or set of outcomes.

- **Probability:** The relative frequency of an event in the population … alternatively… the proportion of times an event is expected to occur in the long run.

Types of random variables:

- Two types of random variables

1) ***Discrete random variables*** (countable set of possible outcomes)

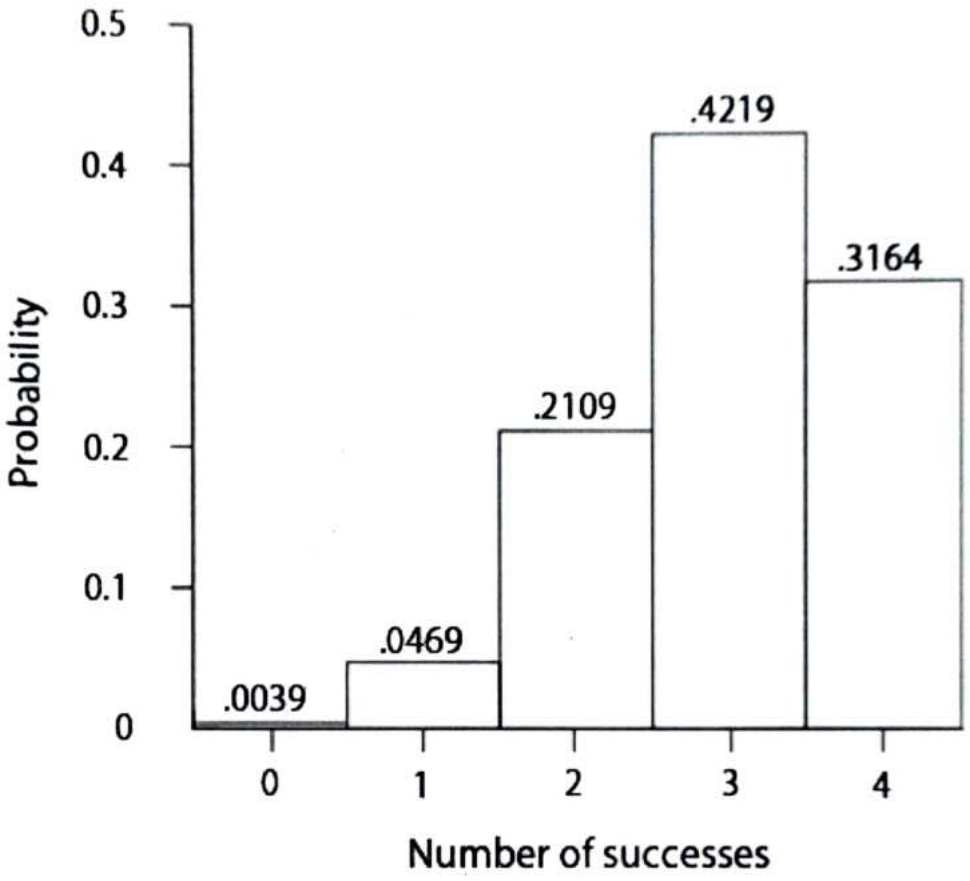
2) ***Continuous random variable*** (unbroken chain of possible outcomes)

EXAMPLE OF DISCRETE RANDOM VARIABLE

- Treat 4 patients with a drug that is 75% effective
- Let $X \equiv$ the [variable] number of patients that respond to treatment
- X is a discrete random variable can be either 0, 1, 2, 3, or 4 (a countable set of possible outcomes
- Discrete random variables are understood in terms of their **probability mass function (*pmf*)**
- ***pmf*** : a mathematical function that assigns probabilities to all possible outcomes for a discrete random variable.
- This table shows the *pmf* for our "four patients" example:

x	0	1	2	3	4
$Pr(X=x)$	0.0039	0.0469	0.2109	0.4219	0.3164

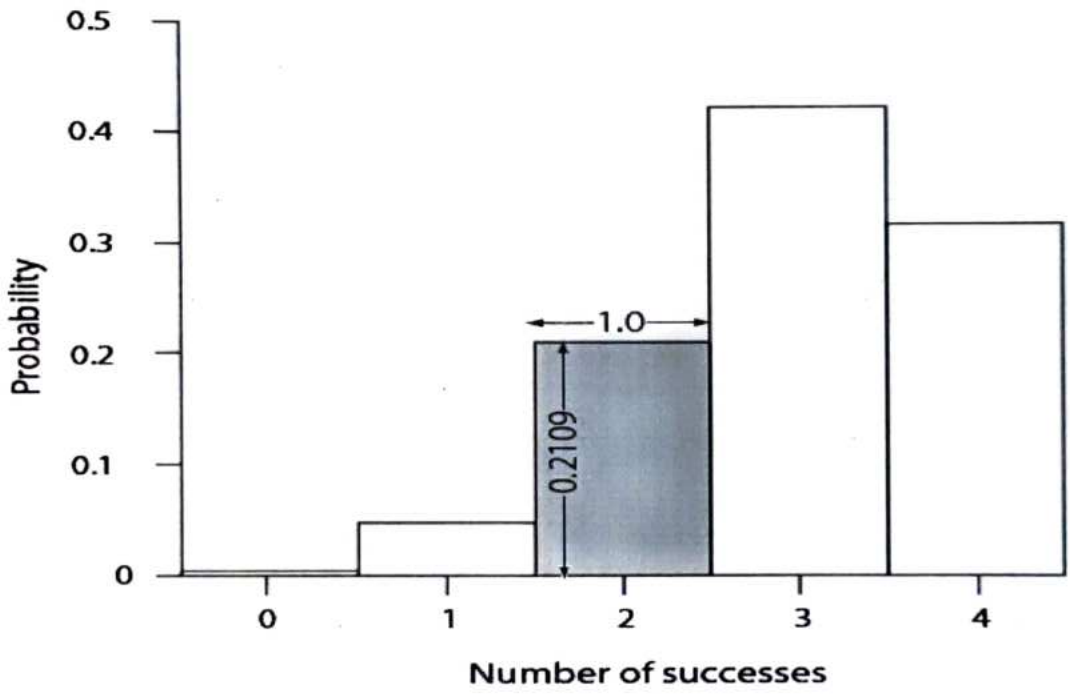
The "four patients" *pmf* can also be shown graphically



Area on pmf = Probability

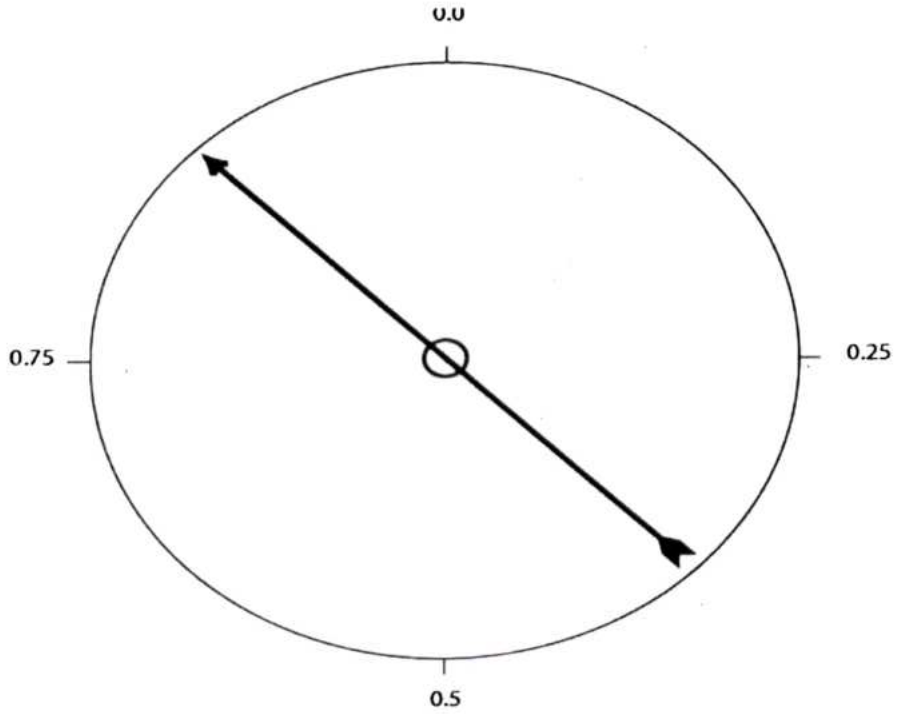
- **Areas under** pmf graphs correspond to probability

- For example:
  Pr(X = 2)
  = shaded rectangle
  = height × base
  = 0.2109 × 1.0
  = 0.2109



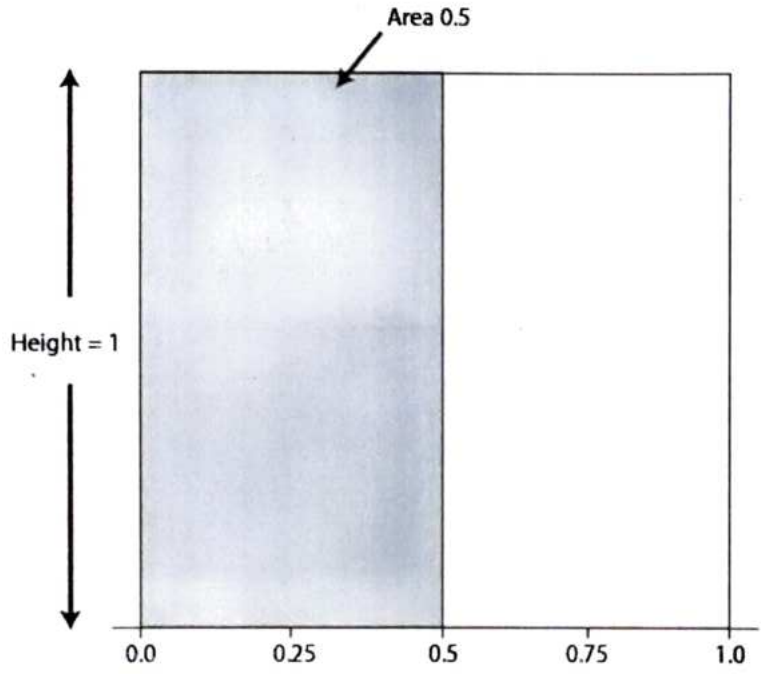
EXAMPLE OF CONTINUOUS RANDOM VARIABLE

- Continuous random variables have an infinite set of possible outcomes
- **Example**: generate random numbers with this spinner



- Outcomes form a *continuum* between 0 and 1

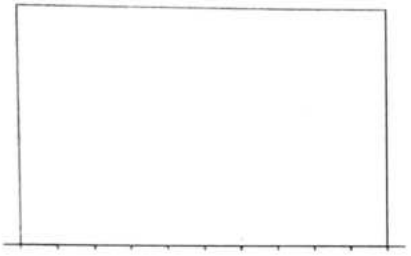
- **probability density function (pdf)**: a mathematical function that assigns probabilities for continuous random variables.
- The probability of any exact value is 0 .
- BUT, the probability of a **range** is the area under the pdf "curve" (bottom)



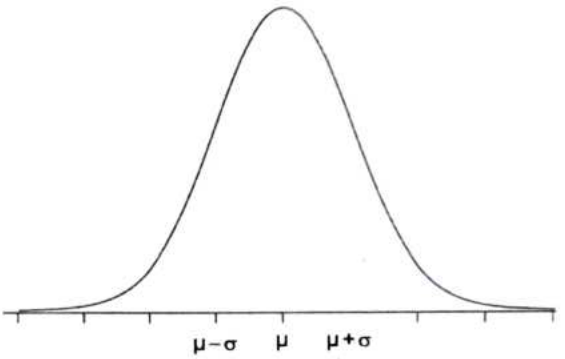
- **Area = probabilities**
- The pdf for the random spinner variable ⇒
- The probability of a value between 0 and 0.5 $Pr(0 \leq X \leq 0.5)$

= shaded rectangle
= height × base
= 1 × 0.5 = 0.5

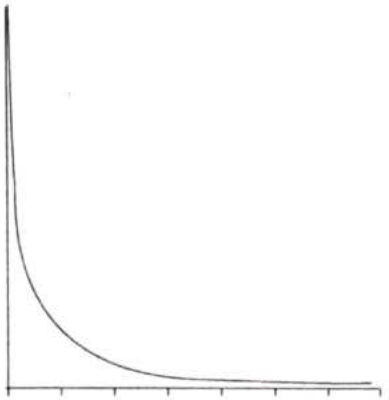
pdfs come in various shapes here are examples



Uniform *pdf*



Normal *pdf*



Chi-square *pdf*

Mahatma Gandhi Arts, Science and Late N. P. Commerce College, Armori

Department of Mathematics

SKILL ENHANCEMENT COURSE (SEC)

Project Work

Topic: Problems in Probability

Class: B.Sc. Sem-V

(Session 2023-24)

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PROBLEMS IN PROBABILITY

INDEX

PROBABILITY

Let A be an event in the sample space S then-

$$\text{Probability of A} = P(A) = \frac{n(A)}{n(S)}$$

Where, n(A) = No. of elements in A

n(S) = No. of elements in S

Basic properties

1. If A′ is the complement of event A then $P(A') = 1 - P(A)$.
2. For any event A in sample space S, $0 \leq P(A) \leq 1$
3. Probability of an impossible event is 0.
4. Probability of a sure event is 1.
5. If $A \leq B$ then $P(A) \leq P(B)$.

Problems:

1) Compute the probability of the occurrence of an event if the probability the event not occurring is 0.56.

Solution:

Given, P(not E) = P(E′) = 0.56

We know that,

P(E) + P(E′) = 1

So, P(E) = 1 – P(E′)

P(E) = 1 – 0.56

$\Rightarrow$ P(E) = 0.44 .

2) In a lottery of 50 tickets numbered 1 to 50, one ticket is drawn. Find the probability that the drawn ticket bears a prime number.

Solution:

Given, Tickets are marked numbers from 1 to 50. And, one ticket is drawn at random.

Total number of tickets is 50, so n(S) = 50.

Tickets which are number as prime number are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47

Total number of tickets marked as prime is 15.

Let A be an event of getting a prime no. ticket then n(A)=15.

We know that $P(A)=\frac{n(A)}{n(S)}$

$$=\frac{15}{50}=\frac{3}{10}$$

Thus, the probability of getting a prime number on the ticket is 3/10.

3) An urn contains 10 red and 8 white balls. One ball is drawn at random. Find the probability that the ball drawn is white.

Solution:

Given, A bag contains 10 red and 8 white balls

Total number of balls 10 + 8 = 18, so n(S)=18.

Total number of white balls is 8.

Let A be an event of getting a white ball at random, so n(A) = 8.

We know that, $P(A) = \frac{n(A)}{n(S)} = \frac{8}{18} = \frac{4}{9}$

Thus, the probability of drawing a white ball from the urn is 8/18 = 4/9.

ADDITION THEOREM

If A and B are any two events then the probability of happening of at least one of the events is defined as -

$$\mathbf{P(AUB) = P(A) + P(B) - P(A \cap B)}$$

❖ If A and B are mutually exclusive events then $P(A \cap B)=0$, so $\mathbf{P(A \cup B) = P(A) + P(B)}$

Problems

1) If P(A) = 0.37 , P(B) = 0.42 , P(A ∩ B) = 0 .09 then find P(A U B) .

Solution:

$P(A) = 0.37$, $P(B) = 0.42$, $P(A \cap B) = 0.09$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$P(A \cup B) = 0.37 + 0.42 - 0.09 = 0.7$

2) What is the probability of drawing either a king or a queen in a single draw from a well shuffled pack of 52 cards?

Solution:

Total number of cards = 52

Number of king cards = 4

Probability of drawing a king card = 4/52

Number of queen cards = 4

Probability of drawing a queen card= 4/52

Both the events of drawing a king and a queen are mutually exclusive

$\Rightarrow P(A \cup B) = P(A) + P(B)$

Therefore, probability of drawing either a king or a queen = 4/52 + 4/52 = 2/13

CONDITIONAL PROBABILITY

1. If P(B) > 0, the conditional probability of A given B is defined as-

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

2. If P(A) > 0, the conditional probability of A given B is defined as-

$$P(B|A) = \frac{P(A \cap B)}{P(A)}$$

PROBLEMS

1) Find the probability that a single toss of a die will result in a number less than 4 if it is given that the toss resulted in an odd number.

Solution:

Let a die is tossed, so n(S)=6.

Let event A: toss resulted in an odd number

and event B: number is less than 4

$\therefore$ A = {1, 3, 5}, SO, P(A) = 3/6 = 1/2

$\therefore$ B = {1, 2, 3}

$\therefore$ A $\cap$ B = {1, 3} and P(A$\cap$B) = 2/6 = 1/3

Hence, required probability = P(number is less than 4 given that it is odd)

$$= P(B/A)$$

$$= \frac{P(A \cap B)}{P(A)}$$

$$= \frac{1/3}{1/2}$$

$$= 2/3.$$

2) The probability that it is Friday and that a student is absent is 0.03. Since there are 5 school days in a week, the probability that it is Friday is 0.2. What is the probability that a student is absent given that today is Friday?

Solution:

The formula of Conditional probability Formula is:

P(B|A) = P(A $\cap$ B)/P(A)

P(Absent|Friday)= P (Absent and Friday)/P(Friday)

$$= 0.03/0.2$$

$= 0.15$

$= 15\ \%$.

MULTIPLICATION THEOREM

If *A* and *B* are any two events of an experiment, then-

$$P(A \cap B) = \begin{cases} P(A)P(B \mid A), & \text{if } P(A) > 0 \\ P(B)P(A \mid B), & \text{if } P(B) > 0 \end{cases}$$

Problems

Q. An urn contains 20 red and 10 blue balls. Two balls are drawn from a bag one after the other without replacement. What is the probability that both the balls drawn are red?

Solution:

Let A and B denote the events that first and second ball drawn are red balls. We have to find P(A ∩ B) or P(AB).

P(A) = P(red balls in first draw) = 20/30

Now, only 19 red balls and 10 blue balls are left in the bag. Probability of drawing a red ball in second draw too is an example of conditional probability where drawing of second ball depends on the drawing of first ball.

Hence Conditional probability of B on A will be,

$P(B|A) = 19/29$

By multiplication rule of probability,

$P(A \cap B) = P(A) \times P(B|A)$

$P(A \cap B) = 20/30 \times 19/29 = 38/87.$

Baye's theorem

Let $E_1, E_2, \ldots, E_n$ be a set of events associated with a sample space S, where all the events $E_1, E_2, \ldots, E_n$ have nonzero probability of occurrence and they form a partition of S.
Let A be any event associated with S, then according to Bayes theorem,

$$P(E_i \mid A) = \frac{P(A \cap E_i)}{P(A)} = \frac{P(E_i)P(A|E_i)}{\sum P(E_k)P(A|E_k)}$$,for any i = 1, 2,....,n

Problems

Q. A bag I contains 4 white and 6 black balls while another Bag II contains 4 white and 3 black balls. One ball is drawn at random from one of the bags, and it is found to be black. Find the probability that it was drawn from Bag I.

Solution:

Let E_1 be the event of choosing bag I
E_2 be the event of choosing bag II
and A be the event of drawing a black ball.

Then, $P(E_1) = P(E_2) = 1/2$

Also, $P(A|E_1)$ = P(drawing a black ball from Bag I) = 6/10 = 3/5

$P(A|E_2)$ = P(drawing a black ball from Bag II) = 3/7

∴ By using Bayes' theorem, the probability of drawing a black ball from bag I out of two bags,

$$P(E_1|A) = \frac{P(E_1)P(A|E_1)}{P(E_1)P(A|E_1)+P(E_2)P(A|E_2)}$$

$$= \frac{\frac{1}{2}\times\frac{3}{5}}{\frac{1}{2}\times\frac{3}{5}+\frac{1}{2}\times\frac{3}{7}}$$

$P(E_1|A)$ = 7/12

ISOLATION, MODIFICATION AND CHARACTERIZATION OF SWEET POTATO STARCH AND ITS APPLICATION IN SELECTED FOOD PRODUCTS

A PROJECT SUBMITTED TO

GONDWANA UNIVERSITY, GADCHIROLI

IN PARTIAL FULFILLMENT OF THREE YEARS FULL TIME GRADUATION DEGREE PROGRAM
B.Sc. III (MICROBIOLOGY)

SUBMITTED BY
MS. GAYATRI BEHARE
(GROUP LEADER)

UNDER THE GUIDANCE OF

Dr. KAVITA KHOBRAGADE
Head
Department of Microbiology

MAHATMA GANDHI ARTS, SCIENCE AND LATE N.P. COMMERCE COLLEGE, ARMORI
SESSION 2023-24

MAHATMA GANDHI COLLEGE ARMORI

UNDER GRAUATE DEPARTMENT OF

MICROBIOLOGY

CERTIFICATE

This is to certify that they are the bonfide student of **B.Sc III (Microbiology)** of this collage for this session 2023-2024. They have completed their dissertation under the guidance of **Dr. K. D. Khobragade** on the project entitled "**ISOLATION, MODIFICATION AND CHARACTERIZATION OF SWEET POTATO STARCH AND ITS APPLICATION IN SELECTED FOOD PRODUCTS**".

The dissertation is being submitted to the **Gondwana University Gadchiroli**, for the partial fulfilment of the requirement for the award of Degree of Batchelor of science in Microbiology.

DATE: 08/04/2024

PLACE: ARMORI

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ACKNOWLEDGEMENT

We are extremely grateful to our principal **Dr. L. H. Khalsa** for his support and permission to carry our project in this college. We express our regards towards **Dr. K. D. Khobragade**, Head of Department of Microbiology, Mahatma Gandhi College Armori. This dissertation was possible only because of her active guidance and infinite help. We express our heartfelt thanks and sincere gratitude for providing all possible facilities in the laboratory. Also, we would like to thanks our non-teaching staff **Mr. Khushal Ramteke** for their help during project. We would like to express our gratitude to our parents for providing moral support and encouragement and our colleagues for having stood by us during the duration of dissertation. We thank almighty for having given us the strength and ability to successfully complete our work with honesty.

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10	CHETNA KHEDKAR		
11	RANU SORTE		

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INTRODUCTION

Starch is the principle carbohydrate in plants with great economic and nutritional importance (Tharanathan, 2002). It can be collected from many vegetable crop sources including wheat, corn, potatoes and rice etc., (Englyst and Englyst, 2005; Katayama *et al.,* 2002).Starch granules comprise of amylose and amylopectin polymers and minor non-carbohydrate components such as ash (minerals), lipids and proteins. Tropical root and tuber crops, such as yam and sweet potato remain underexploited sources of starch for the industry worldwide (Moorthy, 2002).In general, starch is isolated from roots and tubers through rasping, sieving, and decantation or centrifugation (Daiuto, Cereda, Sarmento, &Vilpoux, 2005). The starch properties are dependent on the starch source and also highly dependent on the history of the starch itself, such as extraction procedures. It is known that extraction procedures affect both the chemical composition and physical properties of starch which justify the interest of studying the most suitable isolation method for starch (Correia&Beirao-da-Costa, 2010).

Sweet potato (Ipomoea batatas) is a dicotyledonous plant that belongs to the family Convolvulaceae (Abo-El-Fetoh, Al-Sayed, &Nabih, 2010). Maximum recovery of starch with good physicochemical and functional qualities coupled with an economical extraction of starch from sweet potato is important if this starch is to be exploited in industrial applications (Moorthy, 2002). Yam starch was isolated by four methods using water, pectin, oxalic acid/ammonium oxalate (OA/AO), sodium hydroxide to find the effect of isolation methods on starch properties. Results proved that the smaller starch granules diameter varied from 1.9 mm (OA/AO extraction) to 13.5 mm (water and pectinase extractions). The larger diameter varied from 41.0mm (NaOH treatment) to 67.7 mm (OA/AO). OA/AO extraction showed the best recovery of starch (18%). Treatment with sodium hydroxide showed the highest viscosity values, next to those

with water. Theisolationof yam starch with OA/AOproduced a higher recovery of starch (Daiuto *et al.,* 2005).Yam starch was isolated using different methods (alkali or enzyme or ordinary method). The starch isolated by ordinary method had the highest amylose content while the starch isolated using enzymatic method had the lowest level of amylose. Isolation methods affected the water-binding capacities, swelling powers, and solubility (Wang, Zhang, Li, & Gao, 2011).

Alkaline and enzymatic methods induced changes in the properties of chestnut (Castaneasativa Mill.) fruit starch. Chestnut starch isolated by the alkali method presented the higher values for amylose and resistant starch. An enzymatic method of isolation increased the starch viscosity (Correia,Cruz-Lopes, &Beirao-da-Costa, 2012a). Acorn starches isolated bythe alkaline method presented high amylose content and high paste stability.Isolation showed no effect on solubility and swelling power (Correia, Nunes, &Beirao-da-Costa, 2013).Starch isolated from Jackfruit seed using distilled water showed a higher protein content, starch yield, amylose, and total starch than starch isolated with alkaline and enzymatic methods. While the starch isolated by the enzymatic method presented higher water absorption index and water soluble index (Noor *et al.,* 2014). Pea starch isolated using neutral protease showed the lowest swelling power and solubility while the starch isolated by dry-milling showed the highest value. Alkaline steeping method increased the pasting properties of pea starch (Sun, Chu, Xiong, & Si, 2015).Tef starch isolated using sodium hydroxide as steeping additives showed a lower protein, higher starch purity, small granule size, higher peak viscosity, final viscosity, and higher gelatinization temperature. Steeping with a combination of sodium metabisulfite and lactic acid improved the starch yield (Nyakabau, Wokadala, &Emmambux, 2013)

In an unmodified form, starches have limited use in the food industry. The properties of starches can be improved by various modifications. Modifications can be made to the different starches in order to achieve a more useful end product; these include alterations to a starch‟s gelatinization temperature and changes to the pasting characteristics etc., (Liang & King, 2003).Starch can be modified by the chemical, physical, genetic or enzymatic mean. Acid modification is a chemical method used to prepare thin boiling starches for food and non-food industry applications (BeMiller& Whistler, 2009). Hydrochloric acid and sulphuric acid are the generally used mineral/inorganic acids (Pomeranz, 1991). Hydrochloric acid is an industrially used inorganic acid for acid treatment of starch, but it generates toxic fumes. Inorganic acids may depart a lot of side products that slow down the progress of hydrolysis (Peppler & Perlman, 1980) and indeed they cause some health concern among the consumers. As far as industries are concern, the situation is far more difficult because in spite of extensive washing some residual protein and fat of bounded starch react with HCl to produce colored products like bitter Maillard compounds which carry an additional cost for its removal (Fontana *et al.,* 2008).

Citric acid is renowned as nutritionally safe compared to other substance used for modification of starch (Xie& Liu, 2004). The acid would first hydrolyze the amorphous parts of the starch granules and then hydrolyze the crystalline region, resulting in the production of shorter chains, which would be disorganized through autoclaving and finally reoriented to form more ordered double helix structure during the retro gradation which would prevent the enzyme hydrolysis (Hoover, 2000). Acid hydrolysis reduces the molar mass, and consequently it increases the free aldehyde group content. It also decreases viscosity, increases the solubility of the granules, minimizes syneresis and

causes gel thermo-reversibility when subjected to cooling after melting creating a potential fat substitute for the food industry (Whistler & Daniel, 1990).

Hydrochloric acid treatment slightly decreased the granule size of maize and potato starches. The acid treatment time increased the solubility of starches and gelatinization temperatures (Lin, Lee, & Chang, 2003).Hydrolysis with hydrochloric acid presented changes in the pasting, thermal transition and morphology of the Cola nitida (rubra) starch. Acid hydrolysis increased starch solubility and lowered its swelling capacity (Omojola, Manu, & Thomas, 2011). Acid hydrolysis of sago starchfor12h increased the amylose content and gel strength, after 24h of hydrolysis the molecular weight of amylopectin and amylose decreased. Hydrolysis by acid increased the solubility of starch (Abdorreza, Robal, Cheng, Tajul, &Karim, 2012). Acid hydrolyzedpinhao starch showed low syneresis, high solubility, thermo reversibility and melting point similar to fat (Thys, Aires, Marczak, &Norena, 2013).

Acid treated jicama starches showed low values of gel strength and water solubility index, total sugar content and water absorption index. Gels of hydrolyzed maize and jicama starch showed thermo-reversibility. Acid hydrolysed jicama starch was used as a fat substitute in the preparation of yogurt (Amaya-Llano, Martínez-Alegría, Zazueta-Morales, & Martínez-Bustos, 2008). The granular structures of native and citric acid-heat moisture treated starches exhibited remarkable differences in their shape when observed under the SEM. A decrease in relative crystallinity and gelatinization temperatures were noticed in citric acid-heat moisture treated starch (Liu *et al.,* 2014).Citric acid treatment decreased the swelling power and solubility of cassava starch. Citric acid treatment did not change the X-diffraction pattern, however, the gelatinization temperatures were decreased (Mei, Zhou, Jin, Xu, & Chen, 2015).Acid treatment slightly increased the pasting properties of sweet potato starches whereas it

decreased in arrowroot starch. After acid modification both the starches exhibited lower gelatinization parameters and higher gel strength (Singh, Raina, Bawa, &Saxena, 2005)

Fat replacers are the substances that can replace some or all of the fats in food products and have the potential to help consumers reduce their total fat consumption (American Dietary Association, 2005). Fat replacers are used in the place of natural fats with the objective of obtaining a reduction in the caloric value (Huyghebaert, Dewettinck, &Greyt, 1996). They are categorized as fat substitutes which are fat-based and as fat mimetics which are protein and carbohydrate-based. Carbohydrate-based fat replacers include cellulose, carrageenan, dextrins, gums, pectins, modified starch and vegetable fibers. Protein-based fat replacers include isolated soy protein, microparticulated protein, and modified whey protein. Fat-based fat replacers include mono- and di-glycerides, caprenin, salatrim, and olestra (ADA, 2005). Carbohydrate-based replacers incorporate water into a gel-type structure resulting in lubricant or flow properties similar to those of fats in food systems. It is likely that desirable textures can be achieved using these types of substitutes, and there are few regulatory obstacles regarding any toxicological potential (Akoh, 1998). Starch can also be modified by hydrolysis to form a fat replacer (Sajilata & Singhal, 2004).

The following are the criteria for a starch based fat mimetic – a) Starch should contain an amylose content of ~20% (Vanderveen & Glinsmann, 1992). b) Starch with a granule size of 2-10 μm or in similar size to liquid micelle could act as fat mimetic (Daniel & Whistler, 1990; Malinski, Daniel, Zhang, & Whistler, 2003).c) According to Food and Drug Administation (1982), a starch-based fat mimetic is supposed to be partially or completely digestible. d) Starch must possess a DE (Dextrose equivalent) of ≤ 5.0 (National Starch and Chemical Corporation, 1985). e) Starch gel with a melting point close to that of the fats (37-45 °C) could be used as a fat substitute (Radley, 1976).

f) Starch must possess high water-holding capacity (Vanderveen&Glinsmann, 1992) and better emulsifying properties (Lim *et al.,* 2010). g) Starch should display shear thinning characteristic (Clark, 1994).

A low fat mayonnaise was developed using anenzymatic hydrolyzedcorn starch (granule size 2–4 μm) as a fat replacer. The 60% fat-reduced mayonnaise with fat replacer had similar sensory quality as compared with the high fat mayonnaise (Ma *et al.,* 2006). The addition of acid hydrolysed jicama starch as a fat substitute in the preparation of stirred yogurt produced a good functional and sensorial properties (Amaya-Llano *et al.,* 2008). Yogurt added with acid hydrolyzed starches showed an increase in the percentage of syneresis compared to the control. The low-fat sausages containing heat-stable amylase-modified potato starch as a fat replacer showed the hardness value similar to control sausage. The presence of modified potato starch in reduced-fat sausages increased the product‟s tenderness (Liu, Xiong, Jiang, & Kong, 2008). In a study effect of fat replacers on physical and sensory characteristics of yog-ice cream was investigated. The addition of protein-based fat replacer and carbohydrate-based fat replacer improved the physical and sensory characteristics of the low-fat and fat-free yog-ice creams. The reduced fat yog-ice cream prepared with protein based fat replacer gave the desirable texture and flavor to yog-ice cream (Akin & Guler-akin, 2009).Low-fat ice creams containing protein based fat replacer (Simplesse® D-100) had faster-melting rates than low-fat ice cream with carbohydrate-based fat replacer (Inulin). The use of fat replacer decreased the hardness of ice creams.The reduced fat creams gained similar sensory textural scores to the full-fat sample (Karaca *et al.,* 2009). In a study orange fiber was used as a novel fat replacer in ice cream. The addition of orange peel fiber did not significantly change the physical

(color parameters, melting rate and texture parameters) and sensory properties of the ice creams (Crizel *et al.,* 2014).

Starch is classified based on the extent of digestibility as follows: (Englyst & Hudson, 1997). Rapidly digestible starch (RDS) consists mainly of amorphous and dispersed starch. It is digested quickly in the small intestine. During in vitro testing, it is hydrolysed to the constituent glucose molecules in 20min. RDS is the best exemplified by freshly cooked starchy foods such as mashed potatoes. In this case, starch granule shave been gelatinized and are more accessible to enzymatic digestion. Slowly digestible starch (SDS) like RDS is expected to be completely digested in the small intestine but it is digested more slowly than RDS. During in vitro hydrolysis, SDS is converted to glucose between 20 and110min. This category consists of physically in accessible amorphous starch and raw starch with type A and type C crystalline structure, such as cereals. Resistant starch (RS) is a small fraction of starch that was not hydrolysed after 120min of in vitro hydrolysis by α-amylase and pullulanase treatment. Resistant starch is defined as the sum of starch and products of starch degradation not absorbed in the small intestine of a healthy individual (Englyst, Kingman, & Cummings, 1992).

Resistant starch is subdivided into four categories regarding the mechanism that prevent its enzymatic digestion (Englyst et al, 1992) as follows:a) Resistant starch type I (RS1) represents starch that is resistant because it is physically inaccessible to digestion by entrapment in a non-digestible matrix such as partly milled grains and seeds and in some very dense types of processed starchy food. RS1 is a heat stable in most normal cooking operation and enables its use as an ingredient in a wide variety of conventional foods. b) Resistant starch type II (RS2) represents starch that is a certain granular form and resistant to enzyme digestion. In starch granules, starch is tightly packed in a radical

pattern and is relatively dehydrated. This compact structure limits the accessibility of digestive enzymes and accounts for the resistant nature of RS2. RS2 granules are present in raw potato and banana. c)Resistant starch type III (RS3) represents the most resistant starch fraction and is mainly retrograded starch formed during cooling of gelatinized starch such as cooked and cooled baked potatoes, breakfast cereals. d) Resistant starch type IV (RS4) represents the chemically modified starch such as hydroxyl propyl starch and cross-linking starch. Generally, it is known that RS3 is formed when the linear amylose fraction of starch is retrograded or recrystallized after the gelatinization of starch (Eerlingen & Delcour, 1995). RS3 formed during processing is associated with amylose retro gradation, which is influenced by amylose content, chain length, autoclaving temperature, storage time and temperature (Ozturk, Koksel, Kahraman, & Ng, 2009).

Starch modification by enzymatic methods is of special interest as they are safer for the environment and consumers. The enzymatic reaction can be more specifically controlled under mild conditions and result in fewer by-products (Le *et al.,* 2009). There are many enzymes used in starch hydrolysis to alter the starch structure and to achieve desired functionality. Enzymes hydrolyze α- (1→4) or (1→6) linkages between α-D-glucopyranosyl residues. The most common enzymes for starch modification include α-amylase, β-amylase, glucoamylase, pullulanase, and isoamylase. Pullulanase (pullulan 6-glucanohydrolase, EC3.2.1.41) is a debranching enzyme, which has been gaining importance in starch conversion processes. It cleaves α-1, 6 linkages in pullulan, amylopectin and other related polysaccharides (Lin & Chang, 2006). The increased degree of debranching would give chains more opportunity to align and aggregate to form perfectly crystalline structures, thereby leading to the formation of more RS (Guraya, James, & Champagne, 2001). Enzymatic methods by debranching

treatments have been applied to prepare resistant starch (Miao, Jiang, & Zhang, 2009; Shin, Byun, Park, & Moon, 2004).

Slowly digestible starch was increased when gelatinized waxy maize starch was treated with pullulanase at higher concentration and less debranching time. On the other hand, resistant starch was increased with a higher debranching time (Miao *et al.,* 2009). Similarly, the resistant starch (RS) content of high amylose maize starch was increased with increased debranching time. Debranching caused increases in enthalpy values of maize starch samples Autoclaving–storing cycles after debranching of maize starch caused decreases in viscosity values (Ozturk *et al.,* 2009). Waxy maize starch was treated by pullulanase and retrograded at room temperature to produce resistant starch (RS). The debranching increased the RS3 contents and improved the functional properties of waxy corn starch. Apparent amylose content of maize resistant starch products was increased (Shi, Chen, Yu, &Gao, 2013).Pullulanase debranched waxy rice starch was subjected to repeated crystallization treatment and its physicochemical properties and digestion pattern were investigated by Zeng, Ma, Kong and Gao (2015a). Debranched waxy rice starch treated with four cycles of crystallization produced the highest level of slowly digestible starch and eight cycles of crystallization showed the highest RS content. “Functional Food” is an interesting research area in processed food industry. Several professional and international health organizations have defined functional foods as a food given an additional function by adding new ingredients or more of existing ingredients that provide physiological or health benefits (Feili, Wahidu, Wan Abdullah, & Yang, 2013). Resistant starch has a great interest to product developers and nutritionists for two reasons, the first being the potential physiological benefits and the second the unique functional properties, yielding high-quality products not attainable with traditional insoluble fibres (Fuentes-Zaragoza, Riquelme-Navarrete,

Sanchez-Zapata,&Perez-Alvarez,2010) and it can be applied in several food products, such as breakfast cereals, bakery products and mixtures (Korus, Witczak, Ziobro, &Juszczak, 2009; Sanz-Penella, Wronkowska, Soral-Smietana, Collar, &Haros, 2010), cakes and cookies (Laguna, Salvador, Sanz, &Fiszman, 2011), pastas (Sajilata, Singhal, &Kulkarni, 2006; Gelencer, Gal, Hodsagi, &Salgo, 2008) and in some special applications as well, for example in pudding (Ares, Baixauli, Sanz, Varela, & Salvador, 2009), yoghurt (Fuentes-Zaragoza *et al.,* 2010), cheese-imitation (Arimi, Duggan, O,,Riordan, O,,Sullivan, &Lyng, 2008) and ice cream (Homayouni, Azizi, Ehsani, Yarmand, &Razavi,2008). The amount of RS used to replace flour depends on the particular starch being used, the application, the desired fibre level and in some cases, the desired structure-function claims (Sajilata *et al.,* 2006).

Bread is an important staple food in both developed and developing countries. The development of retrograded amylose (RS3) in bread is known and current interest in adding high-amylose starch to promote RS content, maintain bread quality and reduce starch hydrolysis rates are the focus of many studies (Hung, Yamamori, & Morita, 2005). Corn and tapioca resistant starch were partially replaced with corn starch in gluten-free dough and bread (Korus *et al.,* 2009).Resistant starch incorporated breads showed soft crumb texture than bread without RS addition. The crumb hardness diminished with the increasing amount of applied RS preparation. RS incorporation doesn‟t significantly influence the organoleptic quality of the obtained bread (Korus *et al.,* 2009).Resistant starch prepared from parkia flour was used for the replacement of wheat flour in bread preparation. RS was increased with increase in Parkia flour level in all bread. Incorporation of RS increased the crude protein, ash, and crude fiber content. The color of the bread was remarkably affected by the addition of different levels of RS (Sankhon, Amadou, & Yao, 2013).

Purpose of the study Sweet potato starch is used to produce diverse foods such as vermicelli, noodles, jelly sheets, fried chips, specially flavored yogurt, alcoholic drinks, jam, cake, and steamed bread. However, commercial use of sweet potato starch has been limited. The utility of sweet potato starch can be increased by developing appropriate processing techniques to prepare sweet potato starch with desirable properties. Modification of sweet potato starch by physical, chemical or enzymatic methods may make it more suitable for use in traditional food products that normally use other types of starches. Although, there have been few reports that on the modification of sweet potato starch, technological aspects of sweet potato starch are scarce in the scientific literature. An awareness of its potential uses can help in large-scale cultivation and extraction of starch from the sweet potato crop in India. This information would be beneficial for the better designing of starch-based food ingredients with improved health benefits. Therefore, the overall purpose of the research is to modify the sweet potato starch and evaluate its application in selected food products.

Scope of the study Health concerns have led consumers worldwide to reduce consumption of food high in fat, which had opened the way to growing market for healthy foods with good mouth feel and incorporating natural products only. Thus, producers are motivated to market low-fat products with natural ingredients. So, the use of fat mimetics instead of conventional fats and oils helps in reducing the calorie intake. In this context, result from this research provides information that whether the acid treatment is efficient in producing a potential fat mimetic from the sweet potato starch. Increasing resistant starch content in the diet had the potential to provide several significant health benefits and value to food products. Therefore, knowledge gained

from this research can be applied to develop a process for RS preparation from sweet potato starch and application in an innovative food product.

Based on this background the present study was undertaken with the following objectives:

General objective

To isolate, modify and characterize the sweet potato starch and evaluate its application in selected food products

Specific objectives

To determine the effect of starch isolation methods on properties of sweet potato starch

- To investigate the effect of debranching and retrogradation on the resistant starch formation in sweet potato starch
- To evaluate the incorporation of resistant starch rich starch powder in bread and investigate its effects on the quality characteristics of bread

REVIEW OF LITERATURE

The literature pertaining to a study on Isolation, Modification and Characterization of Sweet Potato Starch and its Application in Selected Food Products is presented under the following headings.

2.1 Structural organization of starch

2.2 Isolation methods of starch

2.3 Chemical Modification of Starch

2.4 Application of resistant starch in food products

2.5 Concluding remarks

2.1 Structural organization of starch

Starch is a storage carbohydrate found in plant sources and is a polymer of D-glucose (Moorthy, 2002).The starch granules are built up in layers around a central core, called a hilum (deMan, 1999). The layers alternate between amorphous and crystalline regions (Katayama *et al.,* 2002). The starch granules are composed of two polymers, amylose, and amylopectin. The proportion of amylose to amylopectin depends on the source of the starch as well as many other factors including the conditions in which the starch has been held (Englyst&Englyst, 2005; Murugesan, Gurunathan, Shibanuma, &Hizukuri, 1993). Amylose is a fraction of starch which is composed of repeating glucose molecules linked with α-D (1-4) linkages (Figure 2.1 A).

Amylose is generally a straight chain or linear polysaccharide that can have a degree polymerization of up to DP 6000 and a molecular mass of around 105 g/mol. The amylose content in native starch can range anywhere from 0 to almost 50% (Sajilata, Singhal, &Kulkarni, 2006).

Amylopectin is the second fraction that is found within the starch. This polysaccharide is a polymer with glucose molecules linked together with α-D(1-4) and α-D(1-6) linkages

(Figure 2.1B). Amylopectin is highly branched and has a degree of polymerization of DP 2 million and a molecular weight of around 109 g/mol making it one of the largest molecules found in nature.The amount of amylopectin present in a starch can be as low as 50% and as high as 100%. Starches with 100% amylopectin are known as waxy starches (Sajilata *et al.,,* 2006).

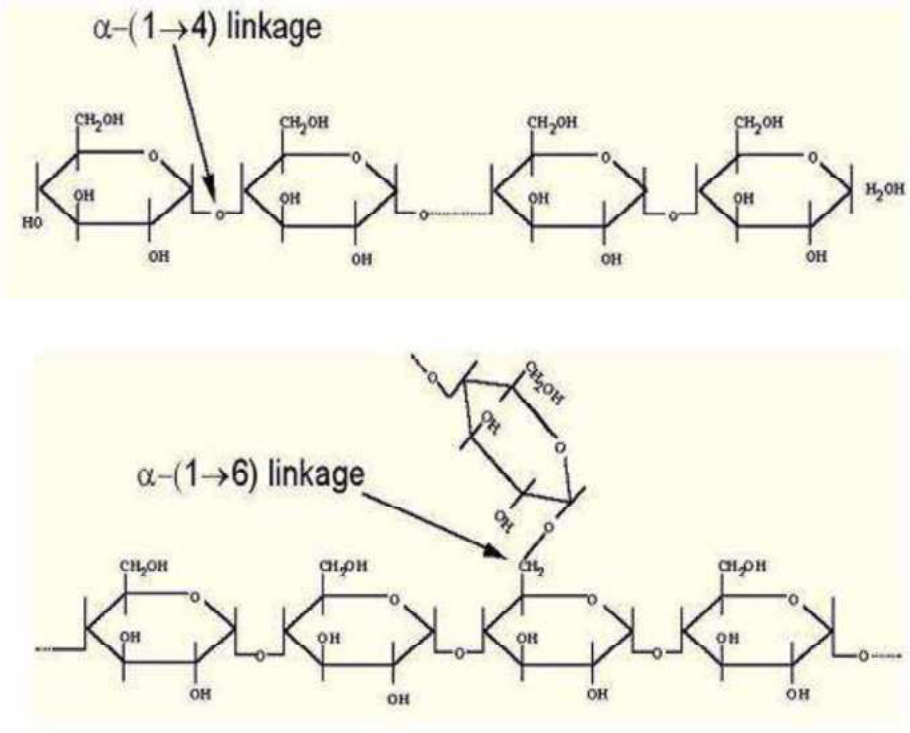

Figure 2.1 Structure of (A) Amylose, (B) Amylopectin (Adapted from Nowjee, 2004)

2.2 Isolation methods of starch

Starches are extracted from the plant material and used in a wide range of products. In the extraction process, starch is separated from the other constitutes of raw material such as fibers, proteins, sugars, and salts. Different isolation procedures affect the chemical composition and physical properties of starch. These changes in starch properties, and even

in starch granule structure, resulting from the isolation procedure are a reflection of the non-rigid organization of starch granules (Singh, Haken, Niu, Zou, &Eckhoff, 1997).Tropical tuber crops elephant foot yam, cush-cush yam,and sweet potato contain starch as the major component and thus, act as an important source of starch (Moorthy, 2002). Starch extraction process from roots and tubers consists in grating the raw material, in order to break vegetal cells and release the starch. This step is followed by passing the fiber through sieves of different mesh sizes and subsequent slurry concentration by decantation or centrifugation (Vilpoux, 2003). Sweet potato (Ipomoea batatas Lam) belongs to the Convolvulaceae family and is considered as the world's most important and under-exploited crop (Sathe &Salunkhe, 1999). Sweet potato starch can be extracted from the fresh root by wet milling and repeated washing with water after a settling time (Collado & Corke, 1997).

Aqueous ammonia solution (0.03M) was used to extract starch from several tuber crops by decantation. There was a noticeable improvement in the yield of starch from Dioscorea and Colocasia while yields decreased in sweet potato starch (Moorthy, 1991). Ji, Seetharaman and White (2004) reported that the sedimentation rather than centrifugation produced greater starch yield (Corn) with the lowest protein content. Isolation had no effect on thermal properties. Moreover, sedimentation is preferred over centrifugation for laboratory starch isolations (especially when the quality of the sample is small) because of the lowered starch-protein content and higher starch yields obtained with sedimentation. Johnston and Singh (2004) used bromalin enzyme during milling process for extraction of corn who found that the starch yield was equal to conventional yield. In a study conducted by Daiuto, Cereda, Sarmento and Vilpoux (2005), extraction of yam starch with ammonium oxalate/oxalic acid showed the best result with an instantaneous loss of mucilage viscosity. Extraction provided a recovery of 18%, the highest among the tested methods (extraction

with sodium hydroxide or water or pectinase). Extraction with sodium hydroxide showed the highest viscosity values, next to those with water. Treatment with pectinase has affected the internal granular structure of starch. Extraction with oxalic acid / ammonium oxalate showed a high recovery of starch.

Park, Bean, Wilson and Schober(2006) investigated the high-intensity ultrasound (sonication) in combination with reducing agents as a method to isolate starch from sorghum and compared with starch isolated by two methods such as an enzymatic method using pepsin A and protein extraction buffer. The starch isolated by sonication method was similar in physicochemical properties to starch isolated using enzymatic and chemical buffer methods of isolation. Protein content and brightness value of sorghum starch isolated using sonication was reduced. Wischmann *et al.,* (2007) isolated potato starch by four scales, which is a laboratory scale, a small and a medium pilot plant scale and in an industrial pilot plant scale. The starch sample isolated by the industry scale contains a higher volume percent of the smallest and the largest granules (approximately 12-150μm). Authors observed that the starch isolated in distilled water showed a significant difference from other isolation scales with low pH, pasting profile and a high number of short amylopectin chains. Correia and Beirao-da-Costa (2010) isolated starches from chestnut (Castaneasativa Mill.) and acorns (Quercussuber Lam. and Q. rotundifolia Lam.) fruits using four different methods. These involved a physicochemical and/or an enzymatic treatment followed by centrifugation and sieving: (i) low shear at alkaline pH–LSA, (ii) high shear in water–HSW, (iii) enzymatic treatment at low shear–LSE, (iv) LSA and using successively three sieves–LSA3S. For all the tested methods, the LSA3S isolation method produced a higher yield and purity. LSA3S method was found to be the most suitable isolation method of starch.

Wang, Zhang, Li and Gao(2011) isolated yam starch with alkali (starch-A) or enzyme (starch-E) and compared with ordinary method (starch-O). The starch-O had the highest amylose content while the starch-E had the lowest level of amylose. The three different starches showed different water-binding capacities, swelling powers, and solubility. Nyakabau, Wokadala and Emmambux (2013) demonstrated the effect of steeping additives (distilled water, sodium metabisulfite, lactic acid, and sodium metabisulfite + lactic acid) on the quality of isolated tef starch. Among the five treatments sodium hydroxide steeps gave the starch with lower protein content, higher starch purity, higher peak viscosity, final viscosity, and small granule size compared to other treatments.

Witono, Santoso, Miryanti and Tan (2013) isolated Canna edulis Ker. Starch using two different types of physical treatments (hydraulic press and screw press) and with the addition of sodium metabisulphite and sodium hydroxide. The results showed that the starch yield and the reduction of fiber were only influenced by the physical treatment whereas ash content in the product was influenced by both the NaOH concentration and physical treatment. Souza, Sbardelotto, Ziegler, Marczak and Tessaro (2016) extracted rice starch using NaOH followed by centrifugation. The obtained starch contains low protein content without any change in the granular structure.

2.3 Chemical modification of starch

The limited application of native starches is due to low shear resistance, thermal resistance, thermal decomposition and high tendency towards retrogradation, high syneresis, sensitive to extreme processing conditions such as pH, temperature etc., (Cousidine, 1982). The limitations experienced from native starch may be overcome by various modifications (Jacobs and Delcour (1998). The basis of starch modification lies in the improvement of its functional properties by changing the physical and chemical properties of such native starch (Ortoefer, 1984). Starch modification which involves the alteration of the physical and

chemical characteristics of the native starch can be used to improve its functional characteristic thereby tailoring it to specific applications (Hermansson and Svegmark, 1996). These modifications can be obtained by chemical, physical, or enzymatic methods. In the chemical method of modification, the effect of acid type and concentration, concentration of alcohol and treatment temperature on different starches were studied from many years (Ma &Robyt, 1987; Fox &Robyt, 1992; Robyt,*et al.,,* 1996; Chang*et al.,,* 2006). Acid hydrolyzed starches are produced when a concentrated suspension of starch (30-40 g/100 g solids) is treated with acid (mostly hydrochloric acid and sulfuric acid) at temperatures lower than those of gelatinization (30-60 °C) for one or many hours of reaction time (Fleche, 1985). Hydrochloric acid is an industrially used inorganic acid for acid treatment of starch, but it generates toxic fumes. Inorganic acids may depart a lot of side products that slow down the progress of hydrolysis (Peppler & Perlman, 1980) and indeed, they cause some health concern among the consumers (Fontana *et al.,* 2008). Hence, in this scenario, a natural alternative for the modification of starch with low cost is certainly required. Citric acid is renowned as nutritionally safe compared to other inorganic acids used for modification of starch (Xie& Liu, 2004). Acids cause scission of the glucosidic linkages, thereby altering the structure and properties of the native starch (Singh, Raina, Bawa, &Saxena, 2005). Acid hydrolysis reduces the molar mass, and consequently it increases the free aldehyde group content. It also decreases viscosity, increases the solubility of the granules, minimizes syneresis, and causes gel thermo-reversibility when subjected to cooling after melting creating a potential fat substitute for the food industry (Whistler & Daniel, 1990).

Lin, Lee and Chang (2003) investigated molecular structure and physicochemical properties of acid–alcohol treated maize and potato starches (0.36% HCl in methanol at 25oC for 1–15days). The yields of the modified starches were ranged from 91 to 100%.

The average granule size of modified starches decreased slightly. The solubility of starches, gelatinization temperatures and range of gelatinization increased with the increase of treatment time. Singh *et al.,* (2005) characterized the acid modified sweet potato starches. After modification, the pasting properties of starch was slightly affected while the gelatinization parameters were significantly affected. Further results showed that the gel strength of acid modified starch was increased. Amaya-Llano, Martínez-Alegría, Zazueta-Morales and Martínez-Bustos(2008) found that HCl hydrolyzed jicama starches exhibited low values of gel strength, water solubility index, and water absorption index. Gels of hydrolyzed maize and jicama starch showed thermo-reversibility. In addition, the acid hydrolysed jicama starch was used as a fat substitute in the preparation of yogurt.

Chibuzo (2012) subjected sweet potato starch to acid hydrolysis and observed a decrease in water, oil absorption capacities and pasting properties of the starch. In addition, moisture, ash and protein were significantly affected. Lin, Pan, Hsu, Singh and Chang (2012) investigated the effect of acid treatment on the waxy and normal corn starches with different moisture contents. They reported a decreased peak viscosity, gelatinization temperature and enthalpy of waxy and normal corn starches after acid treatment. In a study,Aparicio-Saguilán*et al.,* (2014) observed that the acid treatment resulted in a reduction in the amylose content of banana starch and a light change in the diffraction peaks of X-ray diffraction patterns. The gelatinization enthalpy was decreased while an increase in the gelatinization range was noticed. Lin Singh, Chen and Chang (2015) observed an enhanced swelling power, solubility and pasting characteristics of corn starches after treated with HCl for different durations.

Ahmed and Auras (2011) investigated the effect of sulfuric acid hydrolysis on rheological characteristics of lentil starch was studied. Lentil starch was converted to gel during heating and exhibited predominant solid-like properties. Acid hydrolysis strongly affected the

rheological properties by lowering gel strength. Dutta, Paul, Kalita and Mahanta(2011) reported that the granule density, solubility and light transmittance of jack fruit seed starch increased after acid hydrolysis. Starch amylose content and crystallinity increased on acid treatment. Liu *et al.,* (2014) found a higher RS content in citric acid-heat treated (CAHT) starches. The granular structures of native and CAHT starches exhibited remarkable differences in their shape. In a study Mei, Zhou, Jin, Xu and Chen (2015) indicated that citric acid treatment significantly increased the resistant starch (RS) content in starch samples. The swelling power and solubility of citrate starch samples were lower than those of native starch. Studies (Amaya-Llano, Martínez-Alegría, Zazueta-Morales, &Martínez-Bustos, 2008; Thys, Aires, Marczak, &Norena, 2013) showed that acid treated starches could be used as a fat replacer in the food product preparations.

2.4 Application of resistant starch in food products

Resistant starch is of interest in the production of food products because of its health benefits. Few researchers have investigated the use of RS in foods, including spaghetti, tortilla, and bread (Goni, Gracia-Diz, Manas, &Calixto1996; Juarez-Garcia, Agama-Acevedo, Sayago-Ayerdi, Ambriz, & Bello-Perez, 2006; Rohlfing, Paez, Hyun, & White,2010).The amount of RS used to replace flour depends on the particular starch being used, the application, and desired fiber level and in some cases the desired structure-function claims (Sajilata *et al.,* 2006). High concentrations of RS3 led to reduced structural integrity and thus, a decrease in quality of the product (Hung, Yamamori, & Morita, 2005; Korus, Witczak, Ziobro, &Juszczak, 2009).

In a study Lin, Czuchajowska and Pomeranz(1994) used resistant starch to partially replace the shortening or wheat flour in a yellow layer cake formulation. For a low level of shortening replacement (12.5%), the cake qualities were improved, but for a high level (37.5%) a decrease in cake volume and an increase in firmness were obtained. Yue and

Waring (1998) indicated that a 15% replacement of flour by RS had no significant effect on cake quality. In an experiment Fuentes-Zaragoza, Riquelme-Navarrete, Sánchez-Zapata and Pérez-Álvarez(2010) observed a panel rated 40% RS loaf cakes as best for flavor, grittiness moisture perception, and tenderness 24 h after baking. RS waffle showed greater crispness than control or traditional fiber.Majzoobi, Hedayati, Habibi, Ghiasi, and Farahnaky (2014) used corn resistant starch (RS) in the production of sponge cake. Increasing the level of RS caused an increase in cake density but a decrease in volume. a maximum level of RS in the sponge cake recipe to produce an acceptable product amounted to 20%.

Wepner, Berghofer, Miesenberger and Tiefenbacher(1999) used citrate starch made from corn, pea, potato and wheat as a source of RS to enrich toast bread, wafers, pasta and extruded products. Changes in product quality were compensated by varying the recipe. The incorporation of RS in pasta products imparts improved textural properties and health benefits (Premavalli, Roopa, &Bawa, 2006). Research findings have found that commercial RS sources added to pasta formulations at 10% and 20% substitution (Hi Maize™ 260, Fibresym™ 70 and HiMaize™ 1043) reduced the in vitro starch digestibility of pasta and with no impact on sensory properties compared to a durum wheat pasta control (Gelencsér, Juhasz, Hodsagi, Gergely, &Salgo, 2008).

Resistant starch enriched pasta has been reported from wheat, banana and sweet potato (Villalobos, Diaz, Acevedo, Tovar, & Perez, 2008; Ovando-Martinez, Sáyago-Ayerdi, Agama-Acevedo, & Bello-Pérez, 2009; Jyothi, Renjusha, Padmaja, Sajeev, &Moorthy, 2012).Aravind *et al.,* (2013) developed resistant starch enriched pasta using commercial RS2 and RS3 and compared to pasta made from 100% durum wheat semolina. Authors noticed that up to 20% substitution of semolina with either RS2 or RS3 starch had no significant effect on the cooking quality characteristics or textural parameters or sensory

properties of cooked pasta. Bustos, Perez and Leon (2013) studied the effects of combining resistant starch type 2 and type 4 on technological and nutritional attributes of pasta. Results conveyed that the resistant starch type 4 pasta contributed mainly to the reduction in cooking loss, resistant starch type 2 pasta produced the most important improvement in technological and nutritional properties of cooked pasta.

Baixauli, Salvador and Fiszman (2008) studied the instrumental texture characteristics of muffins enriched with resistant starch and noted that its addition produced a softer texture; the samples were less hard, elastic and cohesive, reflecting a more tender structure; these effects were more evident at higher concentrations of resistant starch. Sanz, Salvador, Baixauli and Fiszman (2009) investigated the influence of the addition of RS2 and RS3 containing ingredients on texture; color and consumer acceptability of muffins. The addition of all RS types decreased the texture parameters. No differences were found in L* value samples. RS2 containing muffins showed the highest sensory acceptability than RS3 containing muffins. Maziarz *et al.,* (2013) stated that the addition of RS2 to muffins significantly enhanced all sensory characteristics and resulted in a higher mean overall likeability score. While RS2 enriched bread appeared significantly darker in color and had the perception of a well-done crust versus the control. A grainer texture was observed with the chicken curry containing RS2 which did not affect overall likeability.

Gelencser (2009) stated that the commercial resistant starches could be added to bread products up to 20 % without causing changes in sensory properties; however, the physical properties were negatively influenced. Korus *et al.,* (2009) reported that the use of tapioca and corn resistant starch preparations in gluten-free dough and breads resulted in the increase of storage and loss moduli of the dough and increased elastic character. The addition of resistant starch raised the total dietary fibreup to 89%. Sanz-Penella, Wronkowska, Soral-Smietana, Collar and Haros (2010) developed the bread by substitution

of wheat flour with modified pea starch with a high level of RS (PeaP). PeaP addition in wheat bread significantly increased the RS level. Over dose of modified pea starch (30%) negatively affects dough mixing and over mixing behaviour.

Fuentes-Zaragoza *et al.,* (2010) stated that the bread containing 40% RS had greater loaf volume and better cell structure compared with traditional fibres tested. Bustos *et al.,* (2011) showed that incorporation of an RS2 and an RS4 at levels of 2.5–10% in bread reduced the in vitroglycaemic index with minimal impact on sensory quality.Sanz *et al.,* (2007) investigated the effect of resistant starch (RS) type in batter rheology and in the properties of the final battered food. RS type affected batter rheology and battered food properties. RS2 was found to reduce batter viscosity; on the other hand, an increase in batter viscosity was found with RS3. The final color of the battered food was significantly affected by the RS type. Sozer *et al.,* (2007) found that an RS3 had minimal impact on sensory quality at 10% substitution, with better quality than commercial bran spaghetti. Arimi, Duggan, O'Riordan, O'Sullivan and Lyng (2008) have successfully substituted most or all of the fat in imitation cheese with resistant starch without adversely affecting meltability or hardness and conferring the well-established benefit of resistant starch as a functional fibre. Laguna *et al.,* (2011) proved that resistant starch-rich ingredients have good potential for developing fibre-rich biscuits without changing their general features up to 40% of substitution level. Rohlfing *et al.,* (2010) suggested that an addition of RS3 resulted in decreases in pliability, rollability, and cohesiveness to flour tortillas. Menon *et al.,* (2015) demonstrated the effect of a resistant starch fortification in sweet potato flour and starch significantly reduced the starch digestibility and glycaemic index of noodles.

2.5 Concluding remarks

By reviewing the previous literature, it was evident that the isolation procedures affect both the chemical composition and physical properties of starch. In the previous studies isolation

of starches were done with different methods using various chemical solvents (distilled water, sodium hydroxide, sodium metabisulphite, oxalic acid, ammonium oxalate etc.,) and enzymes (protease, pectin, α-amylase). Among the solvents used, starch isolated with sodium metabisulfite and distilled water produced higher yield and purity than other chemicals nevertheless these solvents were economically cheap and produces starch with minor changes. Starch isolated with distilled water produced relatively smaller granules which can be used as a fat mimetic. Enzymes used for isolation of starch affected the structure of starch granule also the application of enzymes for starch isolation makes the process expensive. In this scenario studying the most suitable method for isolation of sweet potato starch is required.

In the unmodified form, starches have limited use in the food industry. The properties of starches can be improved by various modifications. The acid modification is one type chemical method used to modify starches for food industrial application. Hydrochloric acid and sulphuric acid are the generally used mineral/inorganic acids (Pomeranz, 1991). Literature had specified that hydrochloric acid is an industrially used inorganic acid for acid treatment of starch, but it generates toxic fumes. Inorganic acids may depart a lot of side products that slow down the progress of hydrolysis and indeed they cause some health concern among the consumers. Hence, in this context, a natural alternative for the modification of starch with low cost is certainly required. Citric acid is renowned as nutritionally safe compared to other substance used for modification of starch (Xie & Liu, 2004). The advancement of applying citric acid for the treatment of starches was increased as observed in the recent literature. Application and characterization of citric acid on sweet potato starch has not been studied in the literature so far. As a result, this gives a scope for studying the citric acid treatment on sweet potato starch and thereby providing an insight of the acid treated starch for food industrial application. Studies (Amaya-Llano *et al.,* 2008;

Thys *et al.,,* 2013) showed that acid treated starches could be used as a fat replacer in the food products preparations. Medium fat, low-fat, and nonfat products have increasingly gained in popularity and much improvement in the quality of these products has been made in the last two decades (Goff and Hartel, 2013). Ice cream is one of the oldest fat rich delicious dairy products savored by all kinds of people. Developing a reduced fat ice cream of good quality using a modified sweet potato starch as fat replacer was required to meet the desire for consumers to reduce the fat intake.

On viewing the literature many reports were found on the preparation of resistant starch (RS) from different cereal and tuber starches, however very little information exists regarding the preparation and characterization of RS from sweet potato starch. Literature showed that resistant starch can be considerable increased when treated with pullulanase and further stored for retrogradation. It is noteworthy to optimize the RS preparation from sweet potato using pullulanase treatment which could be applied for the preparation of functional foods. Recently, RS was applied in the development of several food products such as breakfast cereals, bakery products etc., Hence the application of sweet potato resistant starch as a functional ingredient for formulation of bread and investigating its quality is noteworthy.

MATERIALS AND METHODS

3.1 EFFECT OF STARCH ISOLATION METHOD ON PROPERTIES OF SWEET POTATO STARCH

3.1.1 Materials

Pink skin sweet potatoes tubers were purchased from Agricultural Market of Armori, Maharashtra, India. Tubers were of a uniform medium size and free from mechanical or pathological injuries. The tubers were placed in a polyethylene bag to prevent loss of moisture during transportation to the laboratory of Department of Microbiology, M. G. College Armori where the analysis was conducted. Sodium metabisulfite, sodium chloride and all other reagents used in the study were purchased from Sigma-Aldrich.

3.1.2 Methods of isolation of sweet potato starch

3.1.2.1 Isolation using sodium metabisulfite (M1)

Starch was isolated from the sweet potato in triplicates as described by Vasanthan (2001). The blending of sweet potato with water was done at a ratio of 1:10 until smooth slurry forms. Sodium metabisulfite of 0.01% (w/v) was added during slurrying. After slurrying, the first filtration was done with double-layered cheesecloth. The resulting filtrate was then subjected to further filtration through a series of polypropylene screens (250, 175, 125, and/or 75 μm) and the filtrate was centrifuged for 20 min at 5000 × g at 20°C. Starch settled (a white layer) at the bottom of centrifuge tube was washed with toluene, oven dried between 30° and

40°C and the dried starch was ground with mortar and pestle into a fine powder.

3.1.2.2 Isolation by sodium chloride (M2)

According to the method of Riley *et al.,* (2006), the edible portion of sweet potato was cut into small pieces and homogenized with 1 M NaCl (900.00 ml) solution using a blender. The mixture was filtered through triple layered cheesecloth; starch was washed with distilled water. The granules were allowed to settle and water was decanted. The sediment was centrifuged at 3,000 ×g for 10 min. Starch was removed, allowed to air dry overnight at room temperature and the dried starch was ground with mortar and pestle into fine powder.

3.1.2.3 Isolation by distilled water (M3)

The sweet potato starch was isolated using the method described by Wickramasinghe, Takigawa, Matsura-Endo, Yamauchi and Noda (2009) with slight modification, the edible portion of sweet potato was cut into small pieces and homogenized with distilled water for 1-2min. The slurry was then passed through double-layered cheesecloth and the filtrate was allowed to settle for a minimum of 3h at room temperature. The precipitated starch was washed three times with distilled water, dried at room temperature for two days and then the dried starch was kept in the oven at 50ºC for three hours. The dried starch was ground with mortar and pestle into fine powder. The yield of starch based on the weight of the raw tubers was determined. The starch was then packed

into an airtight container and stored under dry conditions at room temperature until used for further applications.

3.1.3 Starch yield (%)

The starch yield obtained from sweet potato was calculated by the following formula:

$$\text{Starch yield } \% = \frac{\text{Isolated starch}}{\text{Total amount of raw sweet potato}} \text{ X } 100$$

3.1.4 Functional properties of sweet potato starches

3.1.4.1 Water absorption capacity (WAC) and oil absorption capacity (OAC)

According to Noor *et al.,* (2014) jackfruit seed starch isolated by enzymatic method gave the highest amount of water absorption index as compared to distilled water and alkaline method. This indicates that isolation method affected water absorption capacity of starches. Hence, water absorption capacity was determined for the isolated starches.

Water Absorption Capacity (WAC) and Oil Absorption Capacity (OAC) of sweet potato starches were analyzed according to the method of Abbey and Ibeh (1988). Ten milliliters of water/oil was added to 1 g of the starch sample in a centrifuge tube of known weight. The mixture was allowed to stand for 30 min, centrifuged (3500 ×g, 15 min) and the supernatant was discarded. The tube and the residue were weighed and the gain in weight was regarded as the water/oil absorption capacity.

3.1.4.2 Paste clarity (PC)

Paste clarity (PC) was measured according to the method of Reddy and Seib (1999). Starch (0.05g, db) was suspended in distilled water (5mL) in a glass-stoppered tube and heated at 95^{o} C for 30min with shaking every 5 min. After cooling, the starch clarity was measured on a spectrophotometer at 650nm against the water blank.

3.1.4.3 Swelling power (SP) and solubility(S)

The results of the study conducted by Correia *et al.,* (2012b) showed that starches extracted by alkaline and enzymatic methods displayed low in swelling and solubility values with no significant difference among the samples. Hence, SP and S of the isolated starches were determined.

Swelling power (SP) and solubility(S) of sweet potato starches were determined by the method of Leach, McCowen and Schoch (1959). A 2 g (dry basis) sample was mixed with 180 ml of distilled water in a centrifuge tube and heated in a water bath from 50 to 90°C for 30 min with 10^{o}C interval. After heating, the suspension was centrifuged at 2200rpm for 15 min. The supernatant was drawn off by suction and dried for 4 hours at 120oC in an oven and the percentage of soluble extracted from the starch was calculated. The swelling power was calculated as the weight of the sediment paste per gram of dry starch.

3.1.5 Chemical composition of isolated starches

The chemical composition such as moisture content, dry matter, pH, ash, crude fat, crude protein, apparent amylose and starch content was determined with the following standard methods.

3.1.6 Moisture content and dry matter

Moisture content is an essential factor for a safe storage, as higher moisture contents can lead to microbial damage and subsequent deterioration in quality (Moorthy, 2002). Moisture content in the starch granules may also influence the starch crystallinity (Imberty, Buleon, Tran, & Perez, 1991). Hence, moisture content was analysed for the starches according to the method described by Adebayo, Lateef and Elizabeth (2010). The detailed procedure is given in Appendix I.

3.1.7 Determination of ash

The enzymatic method of starch isolation had resulted in increased ash content in jack fruit seed starch than distilled and alkaline methods (Noor *et al.,*, 2014). For this reason, ash content was analyzed in the study Starch sample (2 g) was weighed into a porcelain crucible. This was transferred into the muffle furnace set at 550°C and left for about 4 hours. About this time it had turned to white ash. The crucible and its content were cooled to about 100°C in air, then room temperature in a desiccator and weighed. The percentage ash was calculated from the formula below:

$$\text{Ash } \% = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times 100$$

3.1.8 pH

Wischmann *et al.,* (2007) observed that the starch isolated in distilled water showed low pH compared to other isolation methods. Hence pH is determined in the present study so as to find if isolation methods affect the pH of the starch sample.

The pH of a starch sample was determined by the method of Benesi (2005). Sample (5g) was weighed in triplicate into a beaker, mixed with 20 ml of distilled water. The resulting suspension stirred for 5min and left to settle for 10 min. The pH of the water phase was measured using a calibrated pH meter.

3.2 FORMULATION AND QUALITY CHARACTERSTICS OF RESISTANT STARCH INCORPORATED BREADS

3.2.1 Preparation of resistant starch rich powder (RSRP)

Starch was isolated from the sweet potatoes by the method of Wickrama singhe, Takigawa, Matsura-Endo, Yamauchi and Noda (2009). The sweet potato starch suspension (20 %, w/v) was gelatinized on a boiling water bath for 15 min under stirring. This gel was autoclaved at 120 °C for 30 min and then the gel was re-dissolved in distilled water to obtain a 10% (w/v) gel solution. The gel was cooled to 50°C. A 2% pullulanase was added to the starch gel and debranching was carried out for 21h at 50°C. Later the sample was heated at 95°C for 20 min, cooled down to room temperature and stored for 24 h at 4°C. Afterwards, the sample was freeze dried and stored in closed plastic containers (Milasinovic, Radosavljevic, & Dokic, 2010).

3.2.2 Preparation of breads

Preparation of breads involved the replacement of wheat flour with 10% and 15% RS using an appropriate amount of RSRP (63.07% RS). The bread without an addition of RSRP was served as control bread (CB). Experimental breads formulated with 10% and 15% RS were named as EB1 and EB2 respectively. Control and experimental breads were prepared firstly by making the water-sugar suspension. Then, flour, yeast, salt and all other ingredients were mixed with the sugar solution in a mixing bowl as per the formulation listed in the Table 3.1.

Table 3.1 Formulation of control bread (CB), experimental bread 1 (EB1) and experimental bread 2 (EB2) for 100g weight basis

Ingredients	**CB**	**EB1**	**EB2**
Flour (g)	100	84.15	76.22
*RSRP (g)	-	15.85	23.78
Dry yeast (g)	1	1	1
Sugar (g)	30	30	30
Salt (g)	1	1	1
Improver (g)	0.5	0.5	0.5
Vanilla powder (g)	0.5	0.5	0.5
Water (ml)	60	60	60

***RSRP –** Contains about 63.07% of RS

Sweet potatoes

Edible portion of tuber

Isolated sweet potato starch

Baked bread loafs

Control (CB) & Experimental breads (EB)

Plate 3.1 Preparation of breads

The dough was optimally mixed using the mixer for about 10 to 15min until the dough became soft and elastic. After mixing, 350 g of the samples was weighed individually and molded into a shape manually and then the fermentation was carried out for 30 min at 32 - 35°C. The molded dough was placed on a greased tray for further proofing in a proofer at 30°C. After 30 min, the dough was placed on a tray and baked in a baking machine at 200°C for 45 min (Plate 3.1). The baking breads were cooled before further testing.

3.2.3 Microbiological analysis of bread

3.2.3.1 Total bacterial count (TBC)

For the determination of total bacterial count, 1 gm of each bread sample was mashed and mixing into 9 ml of sterile peptone water. The mixture was thoroughly homogenized and diluted serially to 10−2. About 0.1 ml of a 10-2diluted solution was transferred on a nutrient agar using a fresh pipette and spread as quickly as possible on the surface of the plate with a sterile glass spreader. One sterile spreader was used for each plate. The plates were then kept in an incubator at 37oC for 24hours. The colonies were then counted and expressed as colony forming units per gram (cfu/g) of samples. All counts were done in duplicate using the Stuart scientific colony counter (Harrigan & Mclance, 1976).

3.2.3.2 Storage studies

Breads packed in the polyethylene covers are stored at room temperature for four days. Effect of storage period on moisture content, starch fractions, color, textural and microbial properties were determined for 0th day, 2nd day and 4th day of storage interval. Sensory analysis was carried out during the storage interval.

3.3 Stastical Analysis

All data presented were the mean of three independent determinations. The statistical significance of data was tested by one-way analysis of variance (ANOVA) and Critical difference (CD) was performed to examine the significant differences among experimental mean values. Pearson correlation (r) was also

computed using a Minitab-2017 to find the relationship among the chemical and functional properties of isolated sweet potato starches

RESULTS AND DISCUSSION

4.1 Starch yield

The starch yield of tef sample was varied with the isolated methods. Isolation with a combination of sulfur dioxide and lactic acid produced a higher yield of starch (74%) than with distilled water (55%), sulfur oxide (53%), lactic acid (61%) and sodium hydroxide (30%) (Nyakabau *et al.,*, 2013). The starch yield of corn isolated by the alkaline steeping method was 51.03% while, the acid steeping method produced lowest yield (39.76%) (Palacios-Fonseca *et al.,*, 2013). Starch was isolated from sweet potato using Sodium metabisulfite (M_1), Sodium chloride (M_2) and Distilled water (M_3) and these three starches were compared for starch yield. Isolation with only distilled water (M_3) yielded the greatest amount of starch (10.20%) followed by Sodium chloride (8.72%) (M_2) and Sodium metabisulfite (M_1) (6.96%) (Figure 4.1).

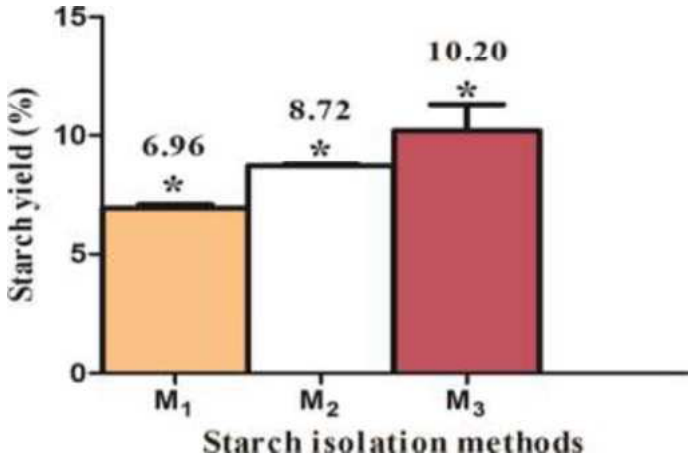

Figure 4.1 Starch yield (%) of sweet potato isolation by using sodium metabisulfite (M_1), sodium chloride (M_2) and distilled water (M_3); * : significant difference at $p < 0.05$

This result was agreed with Noor *et al.,* (2014) who noticed that starch isolated using distilled water obtained the highest amount of starch yield. Brabet *et al.,* (1997) reported that the extractable starch of sweet potato was inthe range of 6.50 - 25.70%. The starch content of sweet potato ranged from 12.38 to 17.52% according to the finding of Thao and Noomhorm (2011).

4.2 Functional properties of isolated starc

4.2.1 WAC, OAC and paste clarity

The results of functional properties of sweet potato starches extracted by the three methods are given in Table 3.1. Water Absorption Capacity (WAC) of sweet potato starches was in the range of 0.62-0.66 ml/g. WAC was related to the interactive forces among starch components, weak interactive forces results in high WAC (Riley *et al.,*, 2006). OAC of sweet potato starch was in the range of 0.66-0.73 ml/g, but it was higher than the OAC (0.15ml/g) of sweet potato starch accounted by Chibuzo (2012). It might be due to the greater hydrophobic tendency than the hydrophilic tendency of isolated starches. Shine and color of a product were influenced by the paste clarity of starch (Abo-El-Fetoh, Al-Sayed, & Nabih, 2010). The paste clarity of sweet potato starch ranged from 0.44 to 0.46. Abo-El-Fetoh, Al-Sayed and Nabih (2010) reported paste clarity for sweet potato starch as 0.33. No significant differences were observed in functional properties such as water absorption capacity, oil absorption capacity and paste clarity among the three isolated starches.

Table 4.1 Functional properties of sweet potato starches

	Starch isolation methods		
Properties	**M_1**	**M_2**	**M_3**

WAC (ml/g)	0.66±0.03 [a]	0.62±0.06 [a]	0.63±0.06 [a]
OAC(ml/g)	0.66±0.05 [a]	0.73±0.05 [a]	0.70±0.06 [a]
Paste Clarity	0.45±0.04 [a]	0.44±0.04 [a]	0.46±0.02 [a]

Mean values followed by the same letters within the row are not significantly different ($p > 0.05$). M_1: isolation using sodium metabisulfite, M_2: isolation using sodium chloride, M_3: isolation using distilled water, WAC: water absorption capacity, OAC: oil absorptioncapacity

4.2.2 Swelling power and solubility

Swelling power of a starch can be associated with starch and its minor components (e.g., proteins and lipids), pre-treatment and processing conditions (Prinyawiwatkul, McWatters, Beuchat, & Phillips, 1997). Theresults of swelling power and solubility of sweet potato starch are shown in Table 3.2.

Table 4.2 Swelling power and solubility of sweet potato starches at different temperature

Temperature (°C)	**Starch isolation methods**		
	M_1	**M_2**	**M_3**
Swelling power(g/g)			
50	3.01±0.28[ac]	3.55±0.10[b]	3.01±0.13[c]
60	4.04±0.04[ac]	4.60±0.06[b]	4.18±0.24[c]
70	5.00±0.13[a]	5.04±0.11[a]	5.01±0.17[a]

80	9.48±1.46[a]	9.96±0.29[a]	9.60±0.98[a]
90	12.08±0.83[a]	14.30±0.88[b]	13.43±0.91[ba]
Solubility (%)			
50	0.77±0.08[a]	0.94±0.21[a]	0.83±0.31[a]
60	1.00±0.53[a]	1.19±0.30[a]	1.02±0.14[a]
70	2.36±0.19[a]	2.47±0.14[a]	2.34±0.17[a]
80	5.52±0.44[a]	5.68±0.28[a]	5.53±0.46[a]
90	6.18±0.50[a]	6.35±0.45[a]	6.13±0.42[a]

Mean values followed by the different letters within the row are significantly different ($p < 0.05$). M_1: isolation using sodium metabisulfite, M_2: isolation using sodium chloride, M_3: isolation usingdistilled water

The swelling power of isolated starches ranged between 3.01and 12.08g/g for M_1 starch, 3.55 to 14.30g/g for M_2 and 3.01 to 13.43g/g for M_3 starch. A significant ($p< 0.05$) difference was observed in swelling power at 50, 60 and 90ºC among the starches isolated through different methods. This result was similar with Huang, Lai, Chen, Liu and Wang (2010) who reported that the swelling power of sweet potato starches was found to be 5.23-16.38g/g with a temperature range of 65-95ºC. The swelling power and the solubility of chest nut starches isolated by alkaline and enzymatic methods presented similar patterns at different temperatures. Swelling power and solubility increased gradually from 60 to 90ºC, for both the isolation

methods (Correia *et al.,*, 2012b). Strong bonded micellar network of the starch polymer was the primary factor in influencing the swelling property (Gujska, Reinhard, & Khan, 1994).

As temperature increased, swelling power was also raised. This might be attributed to the distraction of starch granules at elevated temperature and subsequent release of all the apparent amylose from the amylopectin network (Charles *et al.,*, 2007). The low swelling power of M_1 and M_3 starches might be due to the existence of a huge number of crystallites formed by the association among long amylopectin chains. The swelling power of starch decreases as a result of crystallite formation (Singh, Kaur and Singh 2004). Solubility values were ranged from 0.77-6.18% for M_1, 0.94-6.35% for M_2 and 0.83-6.13% for M_3 starches. No significant difference was observed among the starches. Starch solubility increased with increasing temperatureto 90^{o}C. A similar range of solubility for sweet potato starch was reported by Abegunde, Mu, Arogundade, Deng and Chen (2012). Mweta (2009) also reported the solubility of sweet potato starch was in the range of 0.41-6.4.

4.3 Effect of storage period on microbial content of bread samples

Bread is a type of bakery product which has a shorter shelf-life than most other processed foods. Bread not only loses freshness in terms of crumb softness and flavor with time but also is consequently subjected to microbial spoilage (Baik &Chinachoti, 2000). Results indicated that there were a few bacterial colonies in the control bread while the experimental breads were free of microbial contamination (Table 7.7). The contamination of control bread sample might have occurred during handling and packing of bread

sample since most of the microbes will be inactivated during the high temperature of baking process. Lainez, Vergara and Barcenas (2008) reported that a lot of microorganisms that grow on the bread crust can be inactivated during baking. Furthermore, the products can be re-contaminated with microorganisms after the baking, during cooling, and packaging (Jay, Loessner, & Golden, 2005; Lainez *et al.,*, 2008). Microbial colonies were observed in CB on 0th day while no microbial growth was noticed in EB1 until the second day of storage (Table 4.3).These results are in agreement with the findings of Ayub *et al.,* (2003). Bacteria population in bread samples (CB, EB1) increased from the second day of storage.

Table 4.3 Effect of storage period on microbial content of the bread samples

Microbial content (103cfu/g)	Storage period	CB	EB1	EB2
TBC	0^{th} Day	9.00±4.20	NG	NG
	2^{nd} Day	12.50±7.70	6.50±3.50	NG
	4^{t}Day	36.00±4.20	9.00±2.80	NG

TBC: total bacterial count, NG: no growth. Values are means ± standard deviation of duplicate values.

On the other hand, EB2 indicated no microbial growth during the four days of storage. Free water in food products was responsible for the growth and multiplication of all microbes present in food (FAO, 2009). The high water holding capacity of fibers can be utilized to reduce free water in food systems (Bodner & Sieg, 2009). The high water holding capacity was mainly caused by the greater number of hydroxyl group which exists in the fiber structure and allow more water

interaction through hydrogen bonding (Nasser et at., 2008). Hence, high fibre content in EB2 (20.71%) possibly reduced the free water in the bread and thereby prevented the microbial growth.A similar result was observed in bread with high fibre by Haruna *et al.,* (2011).

Ayub *et al.,* (2003) observed by no microbial colonies during the two days of storage of industrial and local made breads. During the last three days the microbial count was in the range of 25-197cfu/g similar results were noticed by Butt *et al.,* (2001) where microbial colonies in the breads were observed after the 4 days of storage. According to WHO Standards (1994), the maximum permissible limits in baked products for total plate count is 2.0×105cfu/g. Results from the present study indicated that all formulated breads were within safe levels, and will not affect health of the consumers. As storage period increased, the colony count of CB and EB1 samples was increased from 9 to 36×103cfu/g and 6.50 to 9.0×103cfu/g respectively.

SUMMARY AND CONCLUSION

Starch properties are dependent on the starch source but also highly dependent on the history of the starch itself, such as extraction procedures. It is known that extraction procedures affect both the chemical composition and physical properties of starch (Marques & Correia, 2012) which justify the interest of studying the most suitable method for isolation of sweet potato starch. Utilization of starch in food industries was chiefly determined by physical, functional and pasting characteristics (Adebowale & Lawal, 2002). Starches are commonly modified by physical, chemical or enzymatic methods. Acid treatment is one type of chemical modification (BeMiller & Whistler, 2009). Acid modified starches are prepared industrially by treating the starch slurry with mineral acids at 25-55^{o}C for a different time periods (Hoover, 2000). Acid cause scission of the glucosidic linkages, thereby altering the structure and properties of the native starch (Wang & Wang, 2001). Acid hydrolysis reduces the molar mass, and consequently it increases the free aldehyde group content. It also decreases viscosity, increases the solubility of the granules and causes gel thermo-reversibility when subjected to cooling after melting creating a potential fat mimetic for the food industries (Whistler & Daniel, 1990).

Fat replacers are the substances that can replace some or all of the fats in food products that have the potential to help consumers reduce their total fat consumption (ADA, 2005). In the modern diet, there is a trend towards increased consumption of reduced-fat products. One area where this potential exists is the production of fat-reduced ice cream (Markgraf, 1997). Hence, producing an ice cream with reduced fat is considered to fill a gap in the market and fulfill consumer demand. In previous literature acid hydrolysed starch was used as fat mimetic in low fat yogurt preparations (Amaya-Llano *et al.,* 2008).

Resistant starch (RS) was defined as the starch fraction, which escapes digestion in the small intestine and may be fermented in the colon (Haralampu, 2000). There are four different types of RS: they are RS1- Starch which is physically inaccessible and locked within cell walls, RS2- Granular starch that is resistant to digestive enzymes, RS3- Retrograded starch and RS4- Starch that is chemically modified (Eerlingen *et al.,* 1993). Berry (1986) reported that amylopectin of potato starch when debranched using pullulanase before applying heating and cooling cycles considerably improved the RS3 content. In another study conducted by Gonzalez-Soto et al. (2007), debranched banana starch when autoclaved and stored at a temperature of 32oC for 36h gave the highest RS content of around 34%. Foods containing RS moderate the rate of digestion. The slow digestion of RS has implications for its use in controlled glucose release applications. Among the starch-based products bread are the most widely consumed. Bread is a staple food in the human diet in many countries, contributing 50% of dietary energy through its significant carbohydrate content. Typical white wheat bread contains only 1% to 2% RS and a very small amount of slowly digested carbohydrates (Wolever *et al.,* 2003). The incorporation of RS in dough formulations is an important strategy to enhance the RS content in breads. Considering the above points, a study was undertaken with the following objectives General objective

- To isolate, modify and characterize the sweet potato starch and evaluate its application in selected food products

Specific objectives

- To determine the effect of starch isolation methods on properties of sweet potato starch

- To investigate the effect of debranching and retrogradation on the resistant starch formation in sweet potato starch
- To evaluate the incorporation of resistant starch rich starch powder in bread and investigate its effects on the quality characteristics of bread

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COMPARATIVE ESTIMATION OF ANTIMICROBIAL ACTIVITY OF LEAVES OF *Moringa oleifera* AGAINST BACTERIAL ISOLATES

A PROJECT SUBMITTED TO

GONDWANA UNIVERSITY, GADCHIROLI

IN PARTIAL FULFILLMENT OF THREE YEARS FULL TIME GRADUATION DEGREE PROGRAM
B.Sc. III (MICROBIOLOGY)

SUBMITTED BY
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This is to certify that they are the bonfide student of **B.Sc III (Microbiology)** of this collage for this session 2023-2024. They have completed their dissertation under the guidance of **Dr. K. D. Khobragade** on the project entitled "**COMPARATIVE ESTIMATION OF ANTIMICROBIAL ACTIVITY OF LEAVES OF *Moringa oleifera* AGAINST BACTERIAL ISOLATES**".

The dissertation is being submitted to the **Gondwana University Gadchiroli**, for the partial fulfilment of the requirement for the award of Degree of Batchelor of science in Microbiology.

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ACKNOWLEDGEMENT

We are extremely grateful to our principal **Dr. L. H. Khalsa** for his support and permission to carry our project in this college. We express our regards towards **Dr. K. D. Khobragade**, Head of Department of Microbiology, Mahatma Gandhi College Armori. This dissertation was possible only because of her active guidance and infinite help. We express our heartfelt thanks and sincere gratitude for providing all possible facilities in the laboratory. Also, we would like to thanks our non-teaching staff **Mr. Khushal Ramteke** for their help during project. We would like to express our gratitude to our parents for providing moral support and encouragement and our colleagues for having stood by us during the duration of dissertation. We thank almighty for having given us the strength and ability to successfully complete our work with honesty.

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LIST OF PHOTOPLATE

ABBREVATIONS

%	Percentage
_	Negative
+	Positive
° C	Degree Celsius
µl	micro litre
A	Ampicillin
AK	Amikacin
AO	Azetreonem
AT	Azithromycin
C	Chloramphenicol
Ca	Ceftazidime
Cd	Clindamycin
Cep	Cefpodoxime
Cf	Ciprofloxacin
Ch	Cephalothin
Ci	Ceftriaxome
CO	Co-Trimoxazole
CPM	Cefepime
Cs	Cefoperazone
Cu	Cefuroxime
E	Erythromycin
Fc	Fusidic acid
g	Gram
G	Gentamicin

I	**Imipenum**
M	**Molar**
M	**Methicillin**
MHA	**Muller Hinton agar**
Min	**Minute**
mL	**Mili litre**
MO	**Moxifloxacin**
Mr	**Meropenem**
NA	**Nutrient agar**
NaCl	**Sodium chloride**
No.	**Number**
NV	**Novobiocin**
O.D	**Optical Density**
Of	**Ofloxacin**
P	**Penicillin**
pH	**Potential of hydrogen**
Pt	**Piperacillin**
Rpm	**Revolutions per minute**
rRNA	**Ribosomal ribonucleic acid**
S	**Streptomycin**
T	**Tetracycline**
Te	**Teicoplanin**
U	**Unit**
UV	**Ultra Violet**

ABBREVATIONS

%	Percentage
–	Negative
+	Positive
° C	Degree Celsius
µl	micro litre
A	Ampicillin
AK	Amikacin
AO	Azetreonem
AT	Azithromycin
C	Chloramphenicol
Ca	Ceftazidime
Cd	Clindamycin
Cep	Cefpodoxime
Cf	Ciprofloxacin
Ch	Cephalothin
Ci	Ceftriaxome
CO	Co-Trimoxazole
CPM	Cefepime
Cs	Cefoperazone
Cu	Cefuroxime
E	Erythromycin
Fc	Fusidic acid
g	Gram
G	Gentamicin

I	Imipenum
M	Molar
M	Methicillin
MHA	Muller Hinton agar
Min	Minute
ml	Mili litre
MO	Moxifloxacin
Mr	Meropenem
NA	Nutrient agar
NaCl	Sodium chloride
No.	Number
NV	Novobiocin
O.D	Optical Density
Of	Ofloxacin
P	Penicillin
pH	Potential of hydrogen
Pt	Piperacillin
Rpm	Revolutions per minute
rRNA	Ribosomal ribonucleic acid
S	Streptomycin
T	Tetracycline
Te	Teicoplanin
U	Unit
UV	Ultra Violet

INTRODUCTION

Classification of Moringa Plant

Kingdom:	Plantae
Super Division:	Spermatophyta
Division:	Magnoliopsida
Class:	Magnoliopsida
Subclass:	Dilleniidae
Order:	Capparales
Family:	*Morinaceae*
Genus:	*Moringa*
Species:	*oleifera*

Moringa oleifera Lam (syn. M. ptreygosperma Gaertn.) is a tropical plant belonging to family Moringaceae, native of India which was introduced in Brazil around 1950. *Moringaceae* is a single genus family with 13 known species. Among these *oleifera* is most widely used and utilized species (***Sengupta and Gupta,*** **1970; *Morton,* 1991**). The tree originated from Agra and Qudh in the northern eastern region of India, south of Himalayas (***Mugal et al., 1999***). It is cultivated throughout the plains, especially in hedges and in house yards, thrives best under the tropical insular climate, and is plentiful near the sandy beds of rivers and streams (***Qaiser, 1973***). The *Moringa* plant has been consumed by humans throughout the century in diverse culinary ways (***Iqbal and Bhanger***, **2006)**. It can grow well in the humid tropics or hot dry lands, can survive destitute soils, and is little affected by drought (***Morton, 1991***). *Moringa* grows best at altitudes up to 600 m but it will grow at altitudes of 1000 m. It tolerates a wide range of rainfall with minimum annual rainfall requirements estimated at 250 mm and maximum at over 3000 mm and a pH of 5.0-9.0 (***Palada and Changl, 2003***). It will survive in

a temperature range of 25ºC to 40ºC but has been known to tolerate temperatures of 48ºC and light frosts.

The *Moringa* plant is perennial, evergreen tree that grows up to 20 ft tall or ranges from 5 to 10 m (***Morton***, ***1991***), with a straight trunk and a corky, whitish bark. Fruit is long and round with green color when it is young and brown when mature. *Moringa* prefers neutral to slightly acidic soils and grows best in well-drained loam to clay-loam. It tolerates clay soils but does not grow well if waterlogged. *M. oleifera*, native of the western and sub-Himalayan tracts, India, Pakistan, Asia Minor, Africa and Arabia (***Somali et al., 1984; Mugal et al., 1999***) is now distributed in the Philippines, Cambodia, Central America, North and South America and the Caribbean Islands (***Morton, 1991***). India is the largest producer of *Moringa* with an annual production of 1.1 to 1.3 million tons of tender fruits from an area of 380 km². (***Fuglie, 1999***). In some parts of the world *M. oleifera* is referred to as the 'drumstick tree' or the 'horse radish tree', whereas in others it is known as the kelor tree (***Anwar and Bhanger, 2003***). *M. oleifera* is an important food commodity which has had enormous attention as the 'natural nutrition of the tropics'. The leaves, fruit, flowers and immature pods of this tree are used as a highly nutritive vegetable in many countries, particularly in India, Pakistan, Philippines, Hawaii and many parts of Africa (***D'souza and Kulkarni, 1993; Anwar and Bhanger, 2003; Anwar et al., 2005***).

Moringa leaves have been reported to be a rich source of β-carotene, protein, vitamin C, calcium and potassium and act as a good source of natural antioxidants; and thus enhance the shelf-life of fat containing foods due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (***Dillard and German, 2000; Siddhuraju and Becker, 2003***). Humans can produce 10 of 20 essential amino acids *in vivo* while the others must be supplied by a diet of plants or animals. Failure to obtain enough of any one of the 10 essential amino acids that are not formed, results in degradation of the body's

protein and muscle (***Smolin and Grosvenor, 2007***). Plants rich in proteins can be ingested and be broken down metabolically into amino acids, which can supplement the body's need for the 10 essential amino acids which it cannot produce on its own. In the Philippines, it is known as 'mother's best friend' because of its utilization to increase woman's milk production and is sometimes prescribed for anemia (***Estrella et al., 2000; Siddhuraju and Becker, 2003***). Among 13 species, the best studied with regard to potential medicinal uses and the identification of compounds of potential therapeutic importance, is *oleifera*, which is native to the Indian subcontinent.

M. oleifera looses its leaves from December to January and new growth starts in February to March. The leaves are bipinnate or more commonly tripinnate, up to 45 cm long, and are alternate and spirally arranged on the twigs. Pinnae and pinnules are opposite; leaflets are 1.2 to 2.0 cm long and 0.6 to 1.0 cm wide, the lateral leaflets elliptic, the terminal ones obovate; petioles of lateral leaflets are 1.5 to 2.5 mm long, those of terminal ones 3 to 6 mm long. The leaflets are finely hairy, green and almost hairless on the upper surface, paler and hairless beneath, with red-tinged midveins, with entire (not toothed) margins, and are rounded or blunt-pointed at the apex and short-pointed at the base. The twigs are finely hairy and green, becoming brown.

Moringa is not a nitrogen fixing tree, but its fruits, flowers and leaves contain 5-10 % protein on average. All of its parts are eaten widely as vegetables providing excellent food for humans. The pods are eaten like green beans and are reported to contain protein. The edible *Moringa* leaves contain essential provitamins, including ascorbic acid, carotenoids (***Lako et al., 2007***) and tocopherols (***Gomez-Conrado et al., 2004; Sanchez-Machado et al., 2006***). *Moringa* pods also contain amino acids such as argenine and histidine. Its seeds contain 73 % oleic acid similar to olive oil which is used for cooking and also in perfumes. This oleic acid also called as ben oil is excellent in salad and burns with a clear light and without smoke. Seeds of *Moringa*

have antimicrobial activity and utilized as a natural coagulant for water purification (***Kalogo et al., 2000; Anwar et al., 2007***). Pteryospermin is an active compound found in various parts of *Moringa* plant which has antibiotic, bacterial and fungicide properties (***Das et al., 1957***). The flowers, leaves, roots and bark are used in remedies for tumors, abdominal discomfort, conjunctivitis, high blood pressure and skin disease etc. Root- bark of *Moringa* yields an alkaloid, moringinine which acts as cardiac stimulant (***Keharo, 1969***). *Moringa* is rich source of vitamin C and acts as an antioxidant that along with other vitamins protects body from oxidative stress, maintain immune system and aid in absorption of iron. The 5 medicinal plants have greatest potential for benefitting people, especially those living in countries (**like Pakistan**) suffering from poverty, poor health, malnutrition.

Moringa acts as a great natural sleeping aid because it contains the unique natural compound known as Nebedaye, which can be found in the leaves. Nebedayes sets several of the body's key conditions for a fitful night's rest. In one scientific study, it was shown that subject who consumed *Moringa* could stay asleep for up to twice as long as subjects that did not consume any *Moringa.* This makes it useful for those people who wish to stay in a long blissful slumber. On the other hand, the enhanced relaxation and deeper sleep will allow people with a limited number of allotted sleeping hours to awaken more refreshed and energized than they normally would. *Moringa* trees have been used to combat malnutrition, especially among infants and nursing mothers. A large number of reports on the nutritional qualities of *Moringa* now exist in both the scientific and the popular literature. Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. There are various parts of the *Moringa* plant which are being used for health reasons. For one, the leaves of this plant proved to be a good source of calcium, iron, ascorbic acid and phosphorus.

Bacteria are listed at first position among the microorganisms causing opportunistic diseases (***Kone et al., 2004***) various antibacterial agents are currently employed in treating bacterial infections. However, the widespread and indiscriminate use of antibacterial agents resulted in development of drug resistance among many virulently pathogenic bacterial species (***Berkowitz, 1995***). Many of the currently used antibacterial is associated with adverse effects such as toxicity, hypersensitivity, immunosuppression, and tissue residues posing public health hazard. Further, the newer broad spectrum antibiotics are cost prohibitive and are not within the reach of poor Indian farmer. Because of these disadvantages there is a need to find alternative remedies for treatment of bacterial diseases. *Oleifera* is one such plant which is reported to possess several medicinal properties. During recent years considerable work has been done to investigate the pharmacological actions of the leaves and a seed of *M. oleifera* on scientific lines but only limited work has been reported so far on antibacterial activity of *M. oleifera* leaves though it is reported to possess varied medicinal properties. *M. oleifera* is known for its traditional nutritional properties so from the data generated in this study we anticipitate to establish medicinal properties of *M. oleifera*. This can lead to development of new class of antimicrobial in which incidence of resistance should be very low due to lack of selective pressure.

OBJECTIVES OF THE RESEARCH

1. Procurement of bacterial samples.
2. Collection of leaves of *Moringa oleifera* and preparation of its extract.
3. Estimation of antimicrobial activity of leaves of *Moringa oleifera* against standard bacterial isolates.
4. Comparative study of antimicrobial activity of *Moringa oleifera* leaves with standard antibiotics.

REVIEW OF LITERATURE

Since the beginning of human civilization, medicinal plants have been used by mankind for its therapeutic value. Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been isolated from natural sources. Many of these isolations were based on the uses of the agents in traditional medicine. The plant-based, traditional medicine systems continues to play an essential role in health care, with about 80% of the world's inhabitants relying mainly on traditional medicines for their primary health care (***Owolabi et al., 2007***). Medicinal plants are plants containing inherent active ingredients used to cure disease or relieve pain (***Okigbo et al., 2008***). The medicinal properties of plants could be based on the antioxidant, antimicrobial antipyretic effects of the phytochemicals in them (***Cowman, 1999; Adesokan et al., 2008***). The ancient texts like Rig Veda (**4500-1600 BC**) and Atharva Veda mention the use of several plants as medicine. The books on ayurvedic medicine such as *Charaka Samhita* and *Susruta Samhita* refer to the use of more than 700 herbs (***Jain, 1968***). According to the World Health Organization (***WHO, 1977***) "a medicinal plant" is any plant, which in one or more of its organ contains substances that can be used for the therapeutic purposes (***Okigbo, 2009***). The term "herbal drug" determines the part/parts of a plant (leaves, flowers, seeds, roots, barks, stems, etc.) used for preparing medicines. In India, the ayurvedic system has described a large number of such medicines based on plants or plant product and the determination of their morphological and pharmacological or pharmacognosticals characters can provide a better understanding of their active principles and mode of action.

In the last few decades there has been an exponential growth in the field of herbal medicine. It is getting popularized in developing and developed countries owing to its natural origin and lesser side effects (***Brahmachari, 2001***). Herbal drugs constitute a major share of all the officially recognized systems of health in India *viz*. Ayurveda, Yoga, Unani, Siddha, Homeopathy and Naturopathy, except Allopathy. More than 70% of India's 1.1 billion

populations still use these non-allopathic systems of medicine (***Vaidya and Devasagayam, 2007***). In many developing countries, a large proportion of the population relies on traditional practitioners and their armamentarium of medicinal plants in order to meet health care needs. Although modern medicines may exist side-by-side with such traditional practice, herbal medicines have often maintained their popularity for historical and cultural reasons. Such products have become more widely available commercially, especially in developed countries. Use of herbal medicines in developed countries has expanded sharply in the latter half of the twentieth century. In India, herbal drugs are an integral part of The Indian System of Medicine (Ayurveda) which is an ancient and mainstream system (Rai, 2005).

2.1 Moringa

Moringa oleifera is one of the best known medicinal plant. The *Moringa* plant has been consumed by humans (***Iqbal et al., 2006***). It is one of the richest plant sources of Vitamins A, B, C, D, E and K (***Anwar and Bhanger, 2003; Babu 2000; Caceres et al., 1992; Dayrit et al., 1990; Delisle et al., 1997***). The vital minerals present in *Moringa* include Calcium, Copper, Iron, Potassium, Magnesium, Manganese and Zinc. It has more than 40 natural anti-oxidants. *Moringa* has been used since 150B.C. by ancient kings and queens in their diet for mental alertness and healthy skin. The leaves, pods, seeds, gums, bark and flowers of *Moringa* are used in more than 80 countries to relieve mineral and vitamin deficiencies, support a healthy cardiovascular system, promote normal blood-glucose levels, neutralize free radicals, provide excellent support of the body's anit-flammatory mechanisms, enrich anemic blood and support immune system. It also improves eyesight, mental alertness and bone strength. It has potential benefit in malnutrition, general weakness**,** lactating mothers, menopause**,** depression and osteoporosis. It is also used to make an efficient fuel, fertilizer and livestock feed. *Moringa* leaf has been purported to be a good source of nutrition and a naturally organic health supplement

that can be used in many therapeutic ways (***McBurney et al., 2004; Fahey, 2005; DanMalam et al., 2001***).

Moringa was highly valued in the ancient world. The Romans, Greeks and Egyptians extracted edible oil from the seeds and used it for perfume and skin lotion. In the 19th century, plantations of *Moringa* in the West Indies exported the oil to Europe for perfumes and lubricants for machinery. People in the Indian sub-continent have long used *Moringa* pods for food. The edible leaves are eaten throughout West Africa and parts of Asia. For centuries, people in many countries have used *Moringa* leaves as traditional medicine for common ailments. Clinical studies have begun to suggest that at least some of these claims are valid. With such great medicinal value being suggested by traditional medicine, further clinical testing is very much needed. A study was done in Pakistan to examine the physico-chemical characteristics of *M. oleifera* seeds and seed oil from a wild provenance of Pakistan. The *Moringa* seeds exhibited an oil yield of 34.80%. Protein, fiber, moisture and ash contents were 31.65, 7.54, 8.90 and 6.53%, respectively.

Nikolaus Foidl and Dr. Gabrielle Foidl, two Austrian scientists living in Nicaragua, have developed intensive methods of cultivating *Moringa*. They along with their associate Leonardo Mayorga, have been conducting their research in Nicaragua since the early 1990s. They have collaborated with the University of Hohenheim, Germany and with Dr. Michael Kreuzer, ETH (**Swiss Federal Institute of Technology**) Zurich, Switzerland. Their intensive cultivation methods were developed under experimental conditions on plots ranging in size from 0.5 to 4 hectares. Foidl and his associates have experimented with various uses of *Moringa* leaves and green stems, including their use in cattle fodder. Following the Foidl study, a study was conducted by *Dr. Nadir Reyes Sanchez. Dr. Reyes* is on the Faculty of the Veterinary Medicine and Animal Science Department of Animal Nutrition and Management at the Swedish University of Agricultural Sciences in Uppsala, Sweden (***Foidl et al., 2001***).

These two studies in Nicaragua showed that supplementing cattle feed with the leaves and green stems of *Moringa* can increase milk production by 43-65%, and increase daily weight gain in cattle by up to 32%. Recently a new benefit of *Moringa* was suggested: the leaves seem to contain a substance that stimulates plant growth and increases crop production. Several years ago, ***Mr. Nikolaus Foidl*** came across a reference to a study by a Mr. Singh of India. It said that an extract from *Moringa* leaves seemed to stimulate the growth of plants.

About two decades ago, in the southern states of India, and especially in Tamilnadu, *M. oleifera* was cultivated as single trees in homesteads, round cattle sheds, on farm boundaries, and as isolated plants in fences and as groups of trees on village waste lands. In the early 1990s in southern Tamilnadu people started growing perennial types - Moolanoor as an intercrop on field scale and their allies were cropped with vegetables and Sorghum. This system evolved as *Moringa* offered some protection to alley crops from drying winds during summer and *Moringa* provided some additional income. With the migration of people from south to north India, the demand for *Moringa* products increased. In all the places concerned, with their differing conditions, cultivation of *M. oleifera* was not given the required attention and systematic production practices were not followed as people failed to notice that it was a commercially viable alternate crop in Arid Zone Horticulture. (***Anbarassan et al., 2001***). In the Indian sub-continent *M. oleifera* has long been cultivated for its edible fruit: today these are exported, fresh and in tins, to consumers in Asia and Europe. The edible leaves of the tree are very nutritious and are consumed throughout West Africa as well as in some parts of Asia. Powder from seed kernels works as a natural coagulant which can clarify even very turbid water, removing up to 99% of the bacteria in the process. There is need to explore therapeutic, nutritional and benefit of this gift of nature reported to be one of the world's most useful trees. *Moringa* has received attention in many countries in the tropics and sub-tropics and its leaves, pods and seeds form part of the traditional cuisine in these countries. Although *Moringa* is used

in West, Central and East Africa and although it grows in some parts of South Africa, the plant itself, as well as its uses, are mostly unknown to South Africans in general (***National Research Council, 2006***).

Literature study and a few informal discussions held in Tshwane and Mokopane in the Gauteng and Limpopo provinces of South Africa respectively indicated that although some people use *Moringa* in their diets (mostly Indians) its usage is not documented in South Africa. However, the listing of *Moringa* as an herb in South Africa in a recent publication (***Roberts, 2007***) may be an indication that awareness of the plant in South Africa is on the increase. There is therefore an opportunity to introduce *Moringa* as a food source, which could lead to an increase in diversity of the dietary intake, especially among rural populations of South Africa. It has been shown in a recent survey that 33% of South African children under the age of six suffer from vitamin A deficiency (***Coovadia, 2003***). Ramachandran *et al.,* (1980) reported the vitamin A content of *Moringa* as 11,300 IU per 100 g edible portion. The original source did quote the value as beta carotene, which should read 11,300 IU beta carotene per 100 g edible portion (McBurney *et al*., 2004). Babu (**2000**) reported vitamin A content as 3767 IU per 100 g edible portion. A publication of Kuhnlein (**2003**) quoted *Moringa* in Niger as containing 5880 µg beta-carotene per 100 g edible portion. This data of Kuhnlein (2000) is recommended by McBurney *et al.,* (2004). An initiative was launched by FAO to analyse the nutrient composition of traditional leafy vegetables so as to standardise the nutrient content per 100 g edible portion (**FAO, 2008**).

2.2 Applications

According to (***Verma et al., 1976) M. oleifera*** is a fast growing tree being planted in India on large scale as a potential source of wood for the paper industry. The wood provides a pulp that is considered suitable for paper, wrapping, textiles and cellophane. In Jamaica, exudate is used for blue dye.

All of the parts of the *M. oleifera* can be used in a variety of ways as food. It is full of nutrients and vitamins. The leaves, especially young shoots, are eaten as greens, in salads, in vegetable curries, and as pickles. In India, *Moringa* extracts are commonly used as a phytotherapeutic agent. The leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. Dried or fresh leaves are also used in foods such as soups and porridges (Lockett *et al.,* 2000), curry gravy and in noodles, rice or wheat (***Abilgos et al., 1999***). Farmers have added the leaves to animal feed to maintain a healthy livestock (***Sarwatt et al., 2002; Fahey, 2005; Sanchez et al., 2006***) while utilizing the manure and vegetable compost for crop growth (***Fahey, 2005***). Newer applications include the use of *Moringa* powder as a fish food in aquacultural systems (***Dongmeza et al., 2006***). In the West, one of the best known uses for *Moringa* is the use of powdered seeds to flocculate contaminants and purify drinking water (***Berger et al., 1984; Gassenschmidt et al., 1995; Olsen, 1987***) but the seeds are also eaten green, roasted, powdered and steeped for tea or used in curries (***Gassenschmidt et al., 1995***).

Moringa leaves are used as feed for cattle, pigs and poultry. When *Moringa* leaves constituted 40 to 50% of feed, it was found in research studies that milk yields for dairy cows and daily weight gains for beef cattle increased by 30%. The birth weight of calves increased by 3 to 5 kg. Some animals, such as chickens will not voluntarily consume *Moringa* leaves or *Moringa* leaf powder (**Price, 2000**).

The seed of *M. oleifera* contains high quality edible oil (up to 40% by weight). In Haiti, the oil has been used as general culinary and salad oil. It resembles olive oil in its fatty acid composition (***Abdulkarim et al., 2005***). The oil is also used as a lubricant for fine machinery, such as timepieces, for its little tendency of deteriorating and becoming sticky (***Foidl et al., 2001***). Moreover, the oil has the capacity to absorb and retain volatile substance and is therefore valuable in the perfume industry.

After oil extraction of *Moringa oleifera* seeds, the left press cake contains water soluble proteins that act as effective coagulants for water purification. One to two seeds per litre are required for water purification. Seed powders are mixed with water, after hours, the water is filtered to get purified water. The charged protein molecules can serve as nontoxic natural polypeptide to settle mineral particles and organics in the purification of drinking water, vegetable oil, depositing juice (sugarcane) and beer (***Foidl et al., 2001***). Recently, there is an increasing trend to evaluate some indigenous cheaper material for wastewater treatment. Current studies report that *Moringa* seeds and pots are effective sorbets for removal of heavy mental and volatile organic compounds in the aqueous system (***Akhtar et al., 2006, Sharma et al., 2006***). It can be added in oxidation lagoons of wastewater treatment units to coagulate algae as well. The algae are removed by sedimentation, dried and pulverized, and then are used as protein supplement for livestock (***Foidl et al., 2001***). The unique characteristic of *Moringa* seeds could be a possible solution for the developing countries which are suffering from lack of clean drinking water.

Moringa could be used as green compost. The juice from the fresh leaves can be used to produce an effective plant growth hormone (***Price, 2000; Foidl et al., 2001***). This hormone increases the yield by 25 – 30 % for nearly any crop including onion, bell pepper, soya, maize, coffee, tea and other plants. The active substance is zeatin; a plant hormone from the cytokinines group, which is available as a spray.

2.3 Antibacterial activity of *Moringa*

Bacteria are listed at first position among the microorganisms causing opportunistic diseases (***Kone et al., 2004***). Innumerable antibacterial agents are currently employed in treating bacterial infections. However, the widespread and indiscriminate use of antibacterial agents resulted in development of drug resistance among many virulently pathogenic bacterial species (***Berkowitz, 1995***). Many of the currently used antibacterials are associated with adverse effects

such as toxicity, hypersensitivity, immunosuppression, and tissue residues posing public health hazard. Further, the newer broad spectrum antibiotics are cost prohibitive and are not within the reach of poor Indian farmer. These disadvantages undermine the therapeutic utility of the currently available antibacterials and thus necessitating the need for finding alternative remedies for treatment of bacterial diseases. As the global scenario is now changing towards the use of non- toxic and eco-friendly products, development of modern drugs from traditional medicinal plants should be emphasized for the control of various human and animal diseases. *M. oleifera* is one such plant which is reported to possess several medicinal properties. The different parts of this plant viz. leaves, stem bark, root bark, flowers, fruits and seeds are used in the indigenous systems of medicine for the treatment of variety of human ailments (***Chopra et al., 1956; Nadkarni, 1976***). During recent years considerable work has been done to investigate the pharmacological actions of the leaves and seeds of *M. oleifera* on scientific lines but only limited work has been reported so far on antibacterial activity of *M. oleifera* root bark though it is reported to possess varied medicinal properties. Therefore, it was considered worthy to investigate the antibacterial activity of *M. oleifera* root bark. Bark used to cure Dental Caries/Toothache, Common cold, External Sores/Ulcer, Anti-Tumor, Snakebite, Scorpion bite, Digestive, Headache, Antinutrietional factors and Scurvy (***Fahey, 2005***).

In the late 1940's and early 1950's a team from the **University of Bombay** (BR Das), Travancore University (**PA Kurup**), and the Department of Biochemistry at the Indian Institute of Science in Bangalore (PLN Rao), identified a compound they called pterygospermin a compound which they reported readily dissociated into two molecules of benzyl isothiocyanate (***Kurup and Rao, 1952, 1954; Kurup and Rao, 1954; Venkataraman et al., 1954; Das et al., 1954, 1957***). Benzyl isothiocyanate was already understood at that time to have antimicrobial properties. This group not only identified pterygospermin, but performed extensive and elegant characterization of its mode of antimicrobial action in the mid **1950's**. Although others were to

show that pterygospermin and extracts of the *Moringa* plants from which it was isolated were antibacterial against a variety of microbes, the identity of pterygospermin has since been challenged (***Eilert et al., 1981***) as an artifact of isolation or structural determination. Subsequent elegant and very thorough work, published in 1964 as a PhD thesis by Bennie Badgett (a student of the well-known chemist Martin Ettlinger), identified a number of glyosylated derivatives of benzyl isothiocyanate (e.g. compounds containing the 6-carbon simple sugar, rhamnose) (***Badgett, 1964***). The identity of these compounds was not available in the refereed scientific literature until "re-discovered" 15 years later by Kjaer and co-workers (***Kjaer et al., 1979***). Seminal reports on the antibiotic activity of the primary rhamnosylated compound then followed, from U Eilert and colleagues in Braunschweig, Germany (***Eilert, 1978; Eilert et al., 1981***). They re-isolated and confirmed the identity of 4-(α-L-rhamnopy-ranosyloxy) benzyl glucosinolate and its cognate isothiocyanate and verified the activity of the latter compound against a wide range of bacteria and fungi. Extensive field reports and ecological studies forming part of a rich traditional medicine history, claim efficacy of leaf, seed, root, bark, and flowers against a variety of dermal and internal infections. Unfortunately, many of the reports of antibiotic efficacy in humans are not supported by placebo controlled, randomized clinical trials.

Aware of the reported antibiotic activity of and other isothiocyanates and plants containing them, we undertook to determine whether some of them were also active as antibiotics against *Helicobacter pylori*. This bacterium was not discovered until the mid-1980's, a discovery for which the 2005 Nobel Prize in Medicine was just awarded. *H. pylori* is an omnipresent pathogen of human beings in medically underserved areas of the world, and amongst the poorest of poor populations worldwide. It is a major cause of gastritis, and of gastric and duodenal ulcers. Cultures of *H. pylori*, it turned out, were extraordinarily susceptible to and to a number of other isothiocyanates (***Fahey et al., 2002; Haristoy et al., 2005***). These compounds

had antibiotic activity against *H. pylori* at concentrations up to 1000-fold lower than those which had been used in earlier studies against a wide range of bacteria and fungi. The extension of this finding to human *H. pylori* infection is now being pursued in the clinic, and the prototypical isothiocyanate has already demonstrated some efficacy in pilot studies (***Galan et al., 2004; Yanaka et al., 2005***).

Faizi et al.1994; reported the isolation of two nitrile glycosides from the ethanolic extracts of *M. oleifera* leaves, niazirin and niazirinin and three mustard oil glycosides, 4-[(4'-O acetylalpha- L- rhamnosyloxy) benzyl] isothiocyanate, niaziminin A, and niaziminin B. Niazirinin is a new compound. Niaziminins A and B have previously been obtained from the left extract as a mixture. This is the first report of the isolation of nitriles, an isothiocyanate, and thiocarbamates from the same plant species. ***Faizi et al.1995;*** isolated six new and three synthetically known glycosides from the leaves of *M. oleifera*, employing a bioassay-directed isolation method on the ethanolic extract. Most of these compounds, bearing thiocarbamate, carbamate or nitrile groups, are fully acetylated glycosides, which are very rare in nature. Elucidation of the structures was made using chemical and spectroscopic methods, including 2D NMR techniques. ***Murakami et al.1998***; isolated niaziminin, a thiocarbamate from the leaves of *M. oleifera*. ***Bennett et al.2003***; isolated various glucosinolates and phenolic compounds from various parts of *M. oleifera*. ***Karuna Shanker et al.2007***; isolated nitrile glycosides (**niaziridin & niazirin**) from the leaves, pods and bark of *M. oleifera* by reverse phase HPLC. ***Singh et al.2009***; reported presence of gallic acid, chlorogenic acid, ellagic acid, ferulic acid, kaempferol, quercetin and vanillin from the aqueous extracts of leaves, fruits and seeds of *M. oleifera*. The leaves also contains quercetin-3-O-glucoside and quercetin-3-O-(6"-malonyl-glucoside), and lower amounts of kaempferol-3-O-glucoside and kaempferol-3-O-(6"-malonyl-glucoside), 3-caffeoylquinic acid and 5-caffeoylquinic acid.

The *Moringa* plant has been the object of much research due to its multiple uses and well-known bactericidal potential (***Suarez et al., 2003; Ghebremichael et al., 2005***). According to Bezerra *et al.,* the *Moringa* tree is native to northeastern India. It is rich in nutrients and, apart from a range of industrial and medicinal applications, is used to purify water for human consumption (2003). Not surprisingly, as explained by ***Makkar and Becker 1997,*** the *Moringa* is of economic importance in the production of several commodities, such as oils, foods, condiments and medicines. Traditional medicine has a long history of serving peoples all over the world (***Cheng, 2000***). Medicinal plants are an important element of indigenous medical systems that has persisted in developing countries. The plant kingdom was estimated to produce over 500,000 natural products and about 40 to 80 thousand per plant species (***Bhatt, 1995***). Recently, the use of traditional medicine based on plants has received considerable interest (***Han et al., 2002***). There are national and indigenous rights over plant derived resources. Basic scientific investigations based on medicinal plants and indigenous medical systems have increased. It has been estimated that 1 to 10% of the large diversity of 250.000 to 500.000 plant species on the Earth have been studied chemically and pharmacologically for their medicinal properties (***Farnsworth, 1991; Verpoorte, 2000***). Recently a new benefit of *Moringa* was suggested: the leaves seem to contain a substance that stimulates plant growth and increases crop production. Several years ago, Mr. Nikolaus Foidl came across a reference to a study by a Mr. Singh of India. It said that an extract from *Moringa* leaves seemed to stimulate the growth of plants.

MATERIAL AND METHOD

3.1 Microorganisms

Bacterial strains used in the study include standard cultures of MTCC of *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus, Bacillus subtilis* and *Salmonella typhimurium* and various antibiotics susceptible to these strains will be utilized.

3.2 Chemicals

Nutrient agar, Muller – Hinton agar, Muller- Hinton Broth, Peptone and antibiotics were purchase from HiMedia and all other chemicals used were of analytical grade.

3.3 Collection of leaves

The fresh leaves of *Moringa oleifera* were collected in the month of December from Armori village Gadchiroli district of Maharashtra.

3.4 Leave extracts preparation

3.4.1 In aqueous solution

The air-dried fresh leaves of *M. oleifera* were ground to powder and 50 g sample was dipped in 200 mL cold distilled water in a conical flask stoppered with rubber cork and left for 7 days with occasional shaking. Solution was filtered using sterile filter paper (Whattman No. 1) into a clean conical flask and subjected to water bath evaporation where the aqueous solvent were evaporated at its boiling temperature of 100°C and as well as by evaporation under vacuum. The standard extracts obtained were stored in a refrigerator at 4°C for antibacterial activity test (Akueshi *et al.,* 2002).

3.4.2 In organic solvent

3.4.2.1 Ethanol and Ethyl acetate

Leaves of *M. oleifera* were collected and dried in shade. The dried leaves was ground to powder and suspended in petroleum ether and kept in refrigerator overnight. After overnight incubation, the supernatant was discarded and the residue was dried at room temperature. The

residue was further divided into two parts and each part was suspended in ethanol and ethyl acetate respectively in sterile 25 mL conical flasks and kept at 4ºC overnight. After overnight incubation, the supernatant was filtered through Whatman No.1 filter paper and the filtrate was dried to evaporate the organic solvent at room temperature. The standard extracts obtained were then stored in a refrigerator at 4°C for antibacterial activity test (Valarmathy *et al.,* 2010).

3.4.2.2 Methanol and Chloroform

The leave of *M. oleifera* was collected and air dried and pounded into a coarse powder using laboratory pestle and mortar. 30 g of the leaf powder was thoroughly mixed in 450 mL methanol and chloroform respectively and allowed to stand for one hour before filtering with the help of Whatman filter paper No. 1. The filtrate was overnight dried in hot air oven (45°C). The extraction yielded 6 g (methanol) and 3 g (chloroform). The standard extracts obtained were stored in a refrigerator at 4°C for antibacterial activity test (Thilza *et al.,* 2010).

3.5 Antimicrobial activity

Antimicrobial activity antibiotic against standard strains of different bacteria was determined by disk diffusion method (Bauer *et al.,* 1966).

3.5.1 Preparation of stock solutions

Different concentration of *M. Oleifera* leaves were using for this study and the stock solutions of antibiotics were prepared using the formula

$$\frac{1000}{P} \times V \times C = W$$

Where P=Potency given by the manufacturer (µg/mg)

V=Volume required

C=Final concentration of solution (mg/l)

W=Weight of the antimicrobial (mg) to be dissolved in the volume V (ml)

Stocks of antibiotics were prepared in sterile distilled water to generate a 100mg/l solution.

3.5.2 Growth inhibition

The percentage inhibition of bacterial growth was calculated by comparing growth density with antibiotics and leaf extracts and without antibiotics and leaf extracts. Inhibition (%) in growth density was calculated as follows

$$\%Inhibition = \frac{O.D.Control - O.D.Treated\ tubes}{O.D.Control} \times 100$$

3.5.3 Minimal Inhibitory Concentration (MIC)

Well labelled 9 tubes were taken. Add 2 mL of antibiotic solution (100 µg/mL) to the first tube then add 1 ml of sterile broth to all other tubes. Transfer 1 mL from the first tube to the second tube. Using a separate pipette, mix the contents of this tube and transfer 1 mL to the third tube. Continue dilutions in this manner to tube number 8, being certain to change pipettes between tubes to prevent carryover of antibiotic on the external surface of the pipette. Remove 1 mL from tube 8 and discard it. The ninth tube, which serves as a control, receives no antibiotic. Suspend to an appropriate turbidity several colonies of the culture to be tested in 5 mL of Mueller-Hinton broth to give a slightly turbid suspension. Dilute this suspension by aseptically pipetting 0.2 mL of the suspension into 40 mL of Mueller-Hinton broth. Add 1 mL of the diluted culture suspension to each of the tubes. The final concentration of antibiotic is now one-half of the original concentration in each tube. Incubate all tubes at 35°C overnight. Examine tubes for visible signs of bacterial growth. The highest dilution without growth is the minimal inhibitory concentration (MIC) (Murray, 2005).

RESULTS

4.1 Antibiotic activity on bacterial strains

Octatadisc of different antibiotics were used to check antibiotic susceptibility of all five bacterial strains (*Escherichia coli, Staphylococcus aureus, Bacillus subtilis, Salmonella typhimurium, Pseudomonas aeruginosa).* All bacterial strains showed different antibiotic susceptibility with various antibiotics (Fig. 4.2).

4.1.1 *E. coli*

Cefoperazone shows maximum zone of inhibition of 37 mm while Ceftazidime shows minimum zone of 14 mm however cefpodoxime shows no zone against these bacteria. Other antibiotics viz, Moxifloxacin, Amikacin, Gentamycin, Meropenem and Cefepime shows 28 mm, 24 mm, 26 mm, 26 mm, 25 mm zones of inhibition respectively.

4.1.2 *B. subtilis*

Methicillin shows maximum zone of 29 mm while Fusidic acid shows minimum zone of 13 mm. Other antibiotics viz, Penicillin, Streptomycin, Tetracycline, Chloramphenicol, Erythromycin and Novobiocin shows 16 mm, 19 mm, 27 mm, 26 mm, 24 mm and 21 mm respectively.

4.1.3 *P. aeruginosa*

Ciprofloxacin shows maximum zone of 28 mm while Imipenem shows minimum zone of 11mm. Other antibiotics viz, Azetreonem, Amikacin, Piperacillin, Gentamicin, Meropenum and Ceftazidime shows 20 mm, 23 mm, 21 mm, 24 mm, 21 mm, and 21 mm zone of inhibition respectively.

4.1.4 *S. typhimurium*

Ciprofloxacin and Co-Trimoxazole shows maximum zone of 25 mm while Amikacin shows minimum zone of 18 mm. Other antibiotics viz, Cephalothin, Cefuroxime, Gentamicin,

Ampicillin and Ceftriaxome shows 22 mm, 19 mm, 20 mm, 21 mm and 22 mm zone of inhibition.

4.1.5 *S. aureus*

Clindamycin show maximum inhibition zone of 31 mm while vancomycin shows minimum inhibition zone of 18 mm. Other antibiotics Teicoplanin, ofloxacin, Azithromycin, Tetracycline, Penicillin and Erythromycin shows 19 mm, 28 mm, 25 mm, 26 mm, 29 mm, 23 mm zone of inhibition respectively.

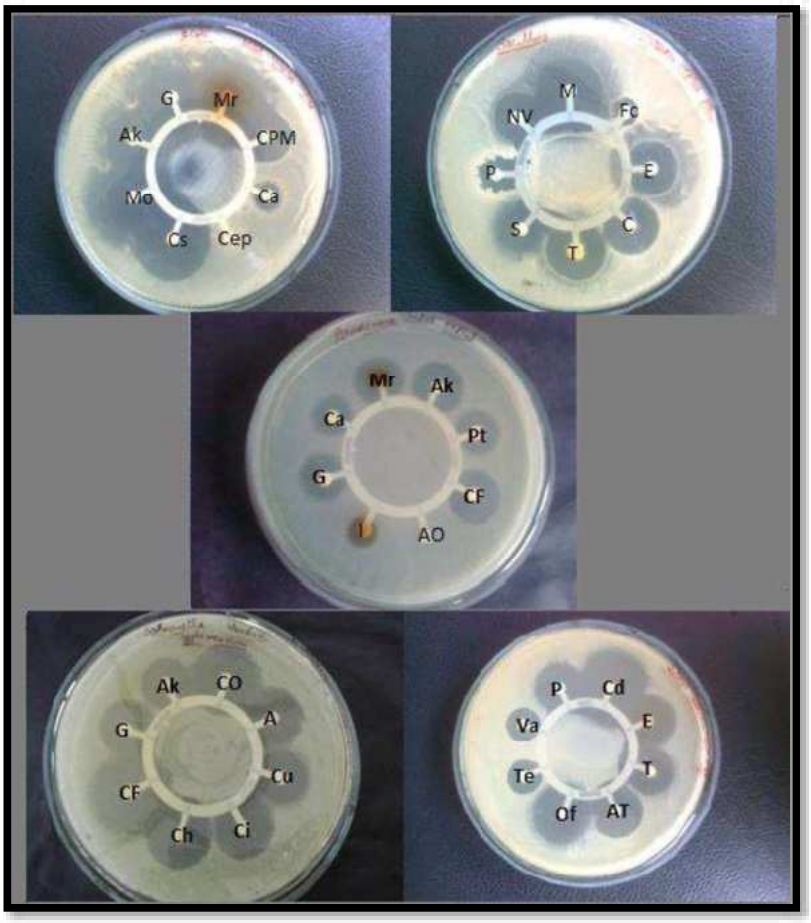


Fig.4.1: Antibacterial activity of different antibiotics against *(a) E. coli (b) B. subtilis (c) P. aeruginosa (d) S. typhimurium and (e) S. aureus*

4.2 Leaves extract activity of bacterial strains

To screen the antimicrobial activity of leaves of *M. oleifera*, all selected bacterial strains was taken as test microbes. Antimicrobial activity was assayed by agar disc diffusion method. The appearance of zone of inhibition is indicated that the leaf extracts were inhibiting the growth of test pathogen, thereby revealing the presence of antimicrobial activity in the leaf extracts.

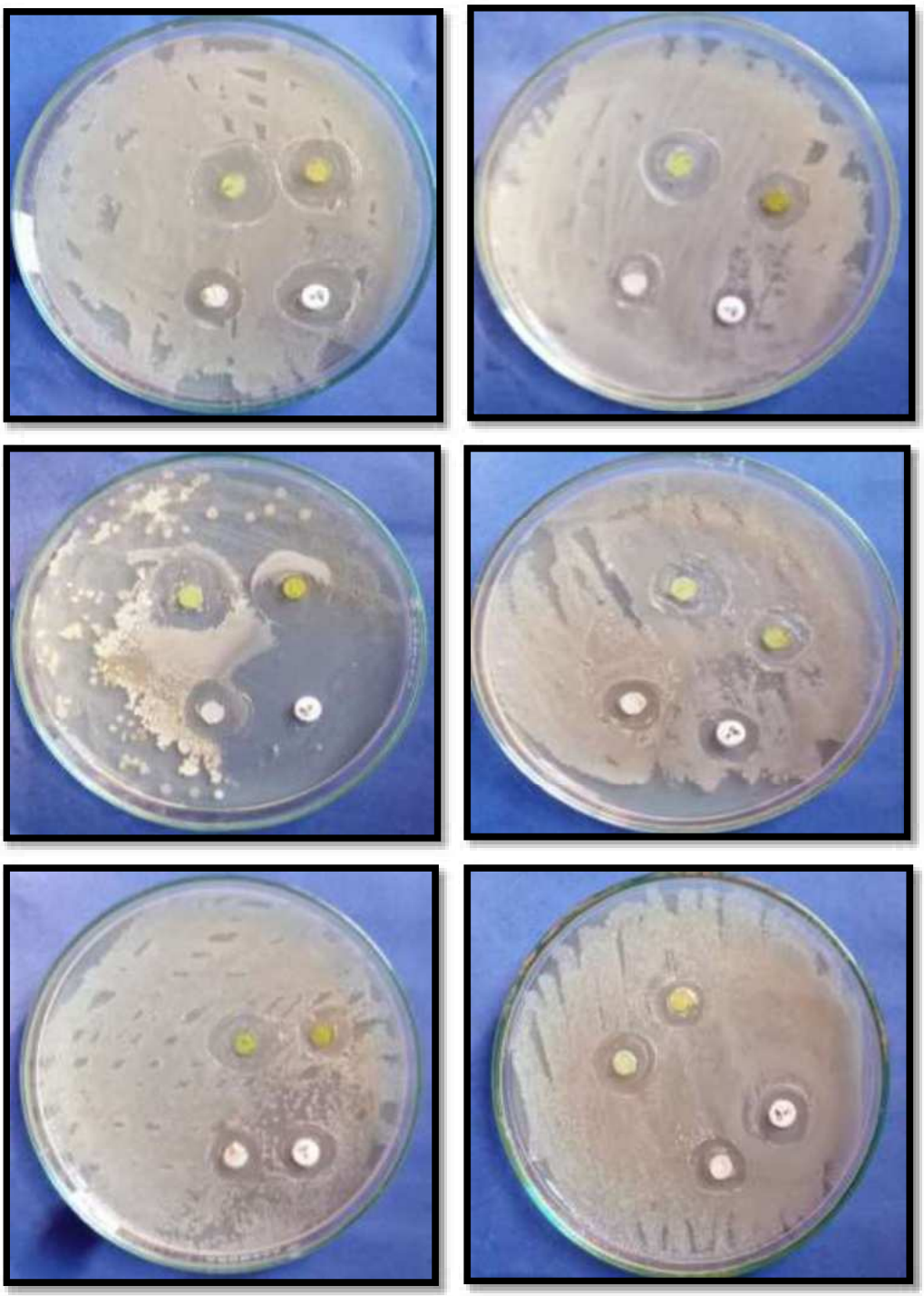
Aqueous extract shows minimum zone of inhibition of 11 mm against *B. subtilis* while ethanol shows maximum zone of inhibition 21 mm against *B. subtilis.* *P. aeruginosa* was highly susceptible to ethanol extract of leaves whereas, less susceptible to ethyl acetate. *S. aureus* showed maximum zone of inhibition of 21 mm against ethanol extract while minimum zone of inhibition against aqueous extract.

Similarly, *E. coli*, and *S. typhimurium* shown maximum zone of inhibition against ethanol extract i.e., 20 mm and 17 mm respectively while, minimum zone of inhibition against chloroform and aqueous extract by observing 14 mm of zone of inhibition for each.

The results obtained by measurement of zone of inhibition are presented in table 4.1. All the extracts of *M. oleifera* leaves inhibit the growth of test microbes but among these extract Ethanol extract were highly active to inhibit test organism followed by methanol, chloroform, ethyl acetate and aqueous extract.

Table 4.1: Comparative estimation of zone of inhibition (mm) of leaves extract

Strain	**Extract**				
	Methanol	**Ethanol**	**Aqueous**	**Ethyl Acetate**	**Chloroform**
S. aureus	17	21	15	19	17
E. coli	18	20	17	15	14
B. subtilis	20	21	11	17	14
P. aerogenosa	15	18	14	11	13
S. typhimurium	16	17	14	15	15



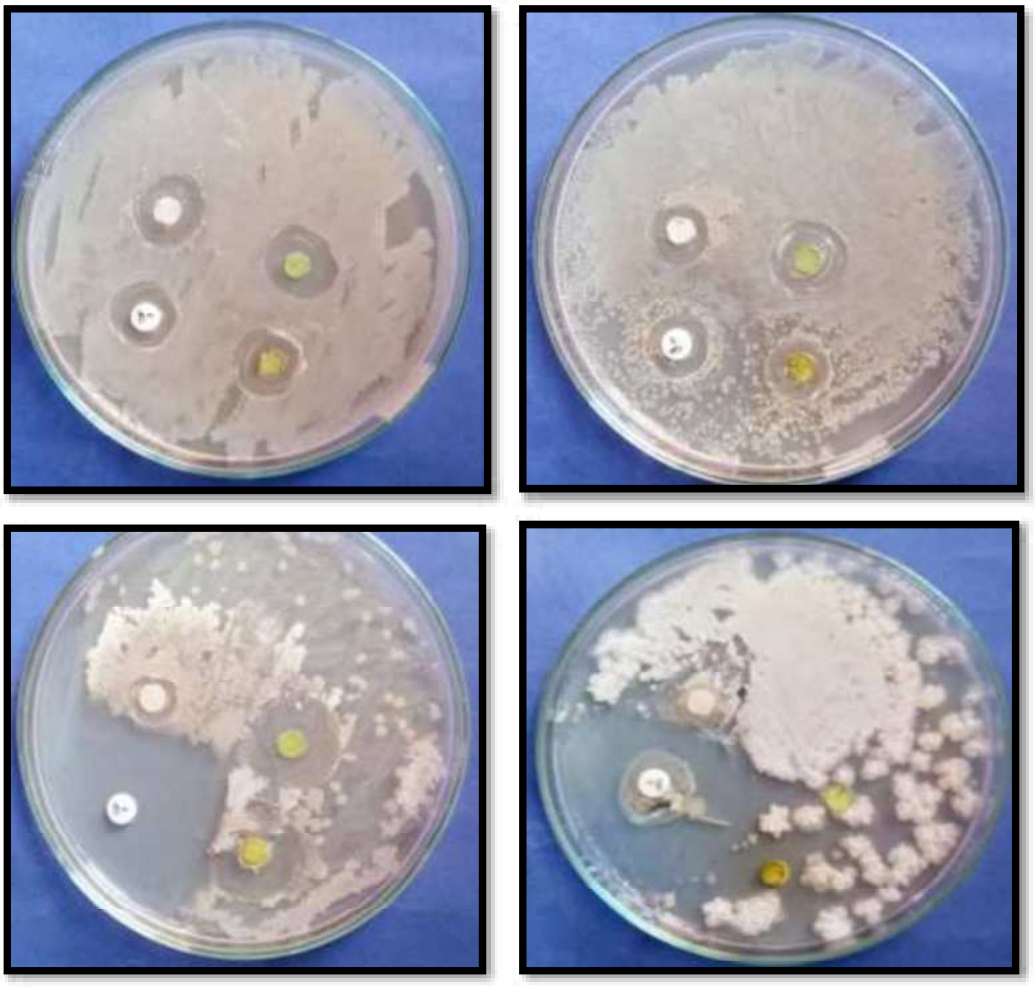


Fig 4.2: Antibacterial activity of different *Moringa* extracts against (a) *E. coli* (b) *B. subtilis* (c) *P. aeruginosa* (d) *S. typhimurium* and (e) *S. aureus*

4.3 Growth inhibition (%) in the presence of antibiotic and leave extract

In the present work four antibiotic were selected which showed minimum zone of inhibition with particular bacterial strain to compare with leaf extract of *M. oleifera.* Growth inhibition (%) of bacterial strain by antibiotics and leaf extract are shown in table 4.2 and Fig. 4.3 showed the graphical parameters of growth inhibition (%) of bacterial strains.

Table 4.2: Growth inhibition (%) of bacterial strain						
Dilutions	**Methanol**	**Ethanol**				**Ethyl Acetate**
(Test tubes)	***B. Subtilis***	***S. aureus***	***E. coli***	***B. Subtilis***	***P. aerogenosa***	***S. aureus***

1	82.97	91.52	94.13	86.63	90.82	91.7
2	69.88	82.22	77.98	80.94	83.47	66.34
3	52.89	77.40	67.68	73.41	78.66	57.09
4	36.18	68.80	61.89	62.14	69.91	45.92
5	27.72	63.61	52.11	48.36	52.91	31.39
6	24.60	49.34	46.28	40.19	33.44	26.11
7	16.36	32.47	32.19	32.45	16.79	20.85
8	6.56	20.43	13.56	8.44	12.55	18.95
Antibiotic						
Dilution Tubes	**Vancomycin (*S. aureus*)**		**Imipenem (*P. aeruginosa*)**		**Fusidic acid *(B. subtilis)***	**Ceftazidime *(E. coli)***
1	92.46		94.68		93.76	96.67
2	91.49		90.12		87.29	93.05
3	90.75		83.87		79.91	83.47
4	88.64		70.94		71.53	73.21
5	84.23		64.19		64.26	66.69
6	81.35		45.42		47.21	46.28
7	54.79		28.76		36.24	35.75
8	24.91		24.16		5.82	16.71

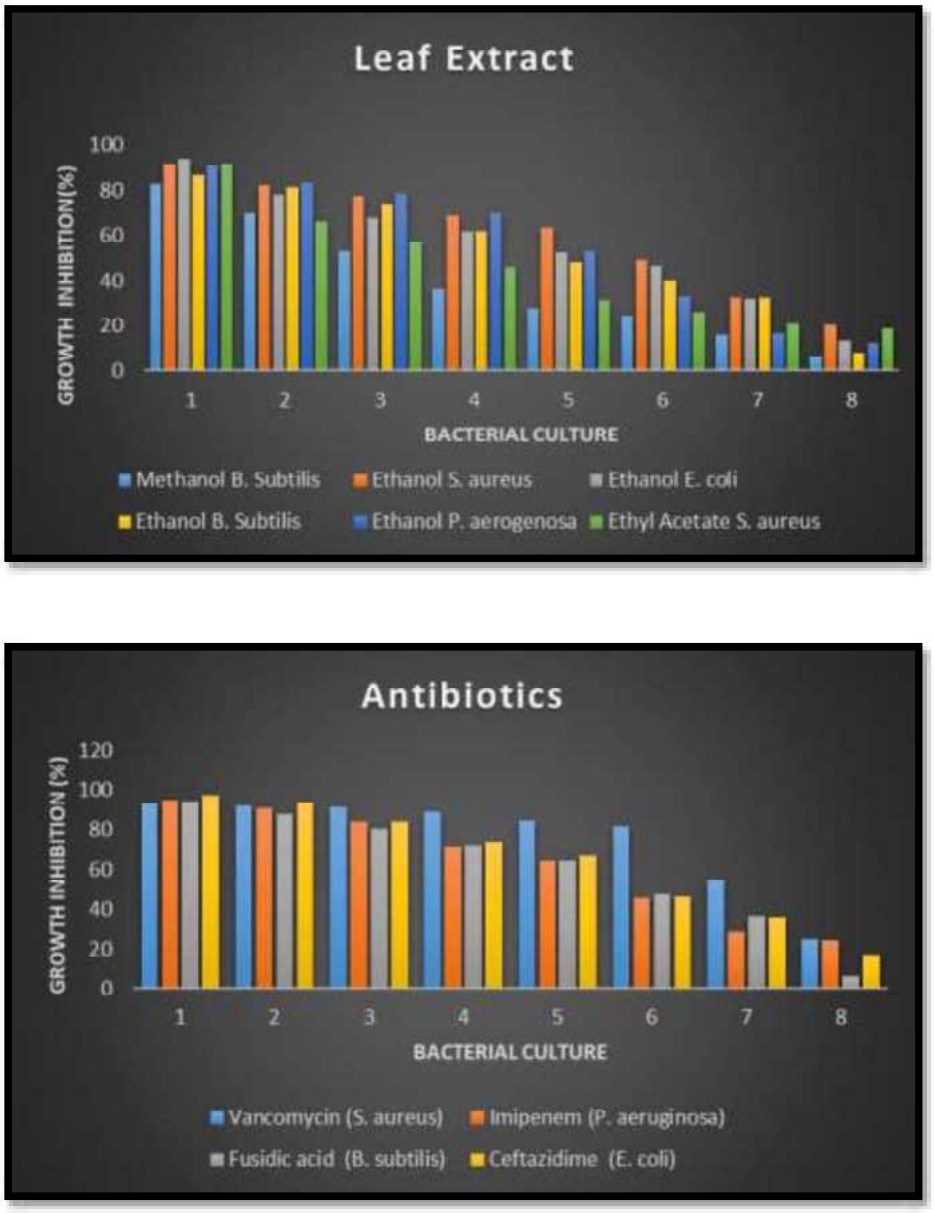


Fig. 4.3: Growth inhibition (%) of bacterial strains by Leaf extract and antibiotics

4.4 MIC Value

MIC values demonstrate that in bacterial strains the most sensitive strain with antibiotic was *P. aerogenosa* (2 mg/mL) and *S. aureus* and *B. subtilis* with leaf extract (20 mg/mL). *S. typhimurium* showed less sensitivity with antibiotic (16 mg/mL) and with leaf extract (36 mg/mL). Comparative table of MIC value of leaf extract and antibiotic are given in table 4.3 and 4.4 respectively.

Table-4.3: MIC value (mg/ml) of leaf extracts					
Strain	**Methanol**	**Ethanol**	**Aqueous**	**Ethyl Acetate**	**Chloroform**
S. aureus	25	20	34	23	26
E. coli	24	21	30	27	28
B. subtilis	22	20	29	25	28
P. aerogenosa	27	24	35	30	30
S. typhimurium	26	25	36	27	27

Table-4.4: MIC value (mg/ml) of antibiotics					
Strain	**Vancomycin**	**Imipenem**	**Fusidic acid**	**Ceftazidime**	**Amikacin**
S. aureus	**8**	-	-	-	
E. coli	-	-	-	**8**	
B. subtilis	-	-	**4**	-	-
P. aerogenosa	-	**2**	-	-	-
S. typhimurium	-	-	-	-	**16**

DISCUSSION

The obtained results demonstrate that the antimicrobial activity of the leaf extract of *M. oleifera* affected predominantly bacterial species. The antimicrobial activity of extract might be due to the presence of lipophilic compounds that might bind within or internal to the cytoplasmic membrane (***Jabeen et al., 2008***). The extract of *M. oleifera* leaves showed antimicrobial activity with all selected bacterial strains. *M. oleifera* leaves extracts worked in doze dependent manner, as the concentration of the extract decreased the activity also decreased, indeed different MIC values were observed against different bacterial strains. This is due to susceptibility of the species towards concentration of the extracts, after which this extract damage, the species which is not tolerable for it (***Ordonez et al., 2006***).

In the last few years various study has been done for its antimicrobial activity from the extract made using chloroform, ethanol (***Bukar et al., 2010***). Where as in the present study antimicrobial activity was observed in leaves extracts prepared with all the solvents viz., ***ethyl acetate, methanol, water, chloroform and ethanol***. However there are no reports of antimicrobial activity against ethyl acetate extract. In present study ethyl acetate extract show zone of inhibition against ***S. aureus, P. aeruginosa, B. subtilis and S. typhimurium.***

In previous papers results of antibacterial activity of *M. oleifera* extracts on food – borne bacterial isolates can be deduced that *M. oleifera* leaf ethanol extract had the broadest spectrum of activity on the test bacteria. The results reveal that it had activity against ***Enterobacter spp.*** (7 mm), ***S. aureus*** (8 mm), ***P. aeruginosa*** (7 mm) and ***E. coli*** (7 mm) and they were sensitive at concentration of 200 mg/ml, while ***S. typhimurium*** were not sensitive at all the concentrations used **(*Bukar et al., 2010***). Napolean *et al.* also reported ***Enterobacter spp, S. aureus, P. aeruginosa, S. typhimurium and E. coli*** to be sensitive to *M. oleifera* leaf ethanol extract at concentration of 200 mg/ml (2009). Various authors have reported antimicrobial activities of plant extracts on food – borne pathogens (***Moreira et al., 2005; Kotzekidou et al., 2007; Afolabi, 2007; Atiqur Rahman and Sun, 2009***).

Other paper shown that full concentration of ethanolic extracts of *M. oleifera* had inhibitory effects on one of the two tested microorganisms ***E. coli*** and ***B. subtilis***. The ethanolic extracts of *M. oleifera*, had no inhibitory effects on other microorganisms. The mean zone of inhibition was found to be 12 mm for that of *E. coli*. While the aqueous extract of the same concentration showed no inhibitory effects on the tested microorganisms. (***Valarmathy et al., 2010***). In present study ethanolic extract shows 12 mm zone against *E. coli* and no zone against *B. subtilis.*

CONCLUSION

In the present work obtained results were compared to antibiotics findings; it could be concluded that the methanol, ethanol and ethyl acetate extract of the leaves obtained from *M. oleifera* was more effective than the standard antibiotics used. According to high antimicrobial activity of the *M. oleifera* leaf extracts further research work should be done using this plant. More studies are needed to isolate and characterize the active compounds to be tested *in vivo* to determine the toxicity and the optimum dose to be used as effective as antibiotics.

SUMMARY

Moringa oleifera, usually mentioned in literature as *Moringa*, is a natural as well as cultivated variety of the genus *Moringa* belonging to family *Moringaceae*. Different extracts of plant leaves shows antibiotic property against wide range of pathogens like *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis and Salmonella typhimurium.* Methanol, ethanol and Ethyl acetate leaves extract showed strong and superior antibacterial activity against all the bacteria. Aqueous extract show less activity compared to remaing extract. So this plant extracts having good healing properties without side effects when compared with antibiotics. The consequences of this investigation suggest that the leaves extract of *M. oleifera* can be used to discover antibacterial agent for developing new pharmaceuticals to control studied human pathogenic bacteria responsible for severe illness

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SKILL ENHANCEMENT COURSE

Affiliated to

GONDWANA UNIVERSITY , GADCHIROLI

Department of PHYSICS

B.Sc. III Year SEM V

Topic Name : Rectifier

Session : 2023-2024

Head of Department : Prof. S.B.Gedam

Guided by: Prof. Dr. C.D.Mungmode

14.10.23

Sign of Head

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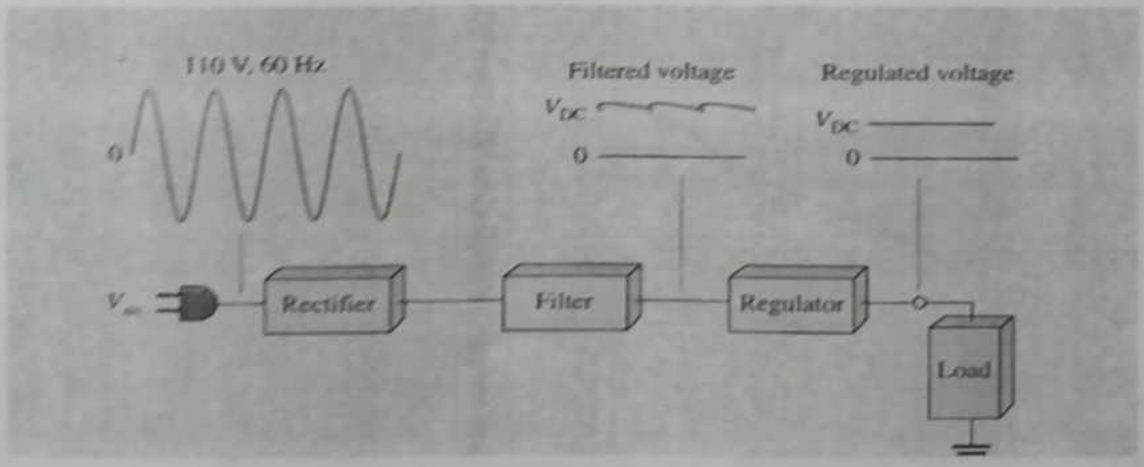
HALF-WAVE & FULL-WAVE RECTIFICATION

Objectives:

- To recognize a half-wave rectified sinusoidal voltage.
- To understand the term 'mean value' as applied to a rectified waveform.
- To understand the effect of a reservoir capacitor upon the rectified waveform and its mean value.

Introduction:

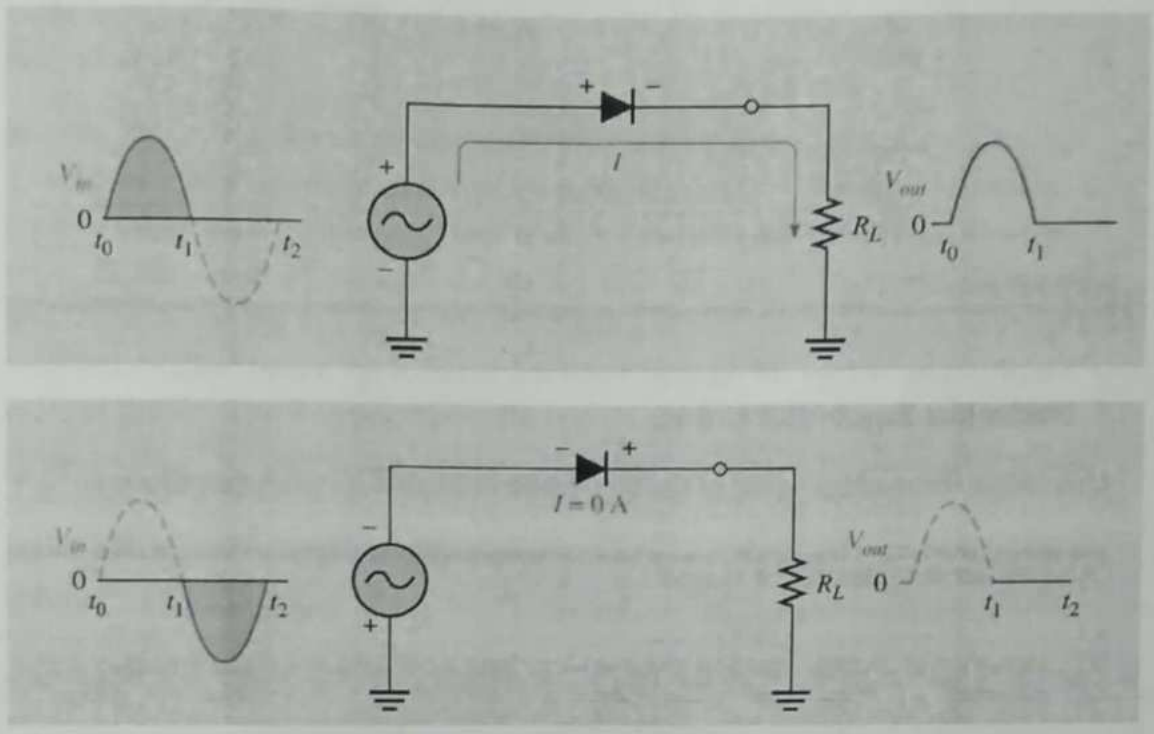
One of the very important applications of diode is in DC power supply as a rectifier to convert AC into DC. DC Power supply is the important element of any electronic equipment. This is because it provides power to energize all electronic circuits like oscillators, amplifiers and so on. In electronic equipments, D.C. Power supply is must. For example, we can't think of television, computer, radio, telephone, mobile as well as measuring instruments like multi-meter etc. Without DC power supply. The reliability and performance of the electronic system proper design of power supply is necessary. The first block of DC power supply is rectifier. Rectifier may be defined as an electronic device used to convert ac voltage or current into unidirectional voltage or current. Essentially rectifier needs unidirectional device. Diode has unidirectional property hence suitable for rectifier. Rectifier broadly divided into two categories: Half wave rectifier and full wave rectifier.



Working principle of half wave rectifier:

In half wave rectifier only half cycle of applied AC voltage is used. Another half cycle of AC voltage (negative cycle) is not used. Only one diode is used which conducts during positive cycle. The circuit diagram of half wave rectifier without capacitor is shown in the following figure. During positive half cycle of the input voltage anode of the diode is positive compared with the cathode.

Diode is in forward bias and current passes through the diode and positive cycle develops across the load resistance RL. During negative half cycle of input voltage, anode is negative with respected to cathode and diode is in reverse bias. No current passes through the diode hence output voltage is zero.



$$\text{Average or mean value(dc value)} = \frac{\text{area under the curve}}{\text{length of base}}$$

$$V_{av} = \frac{\int_0^{\pi} V_p \sin(\theta)}{2\pi} = \frac{V_p}{2\pi}(-\cos(\theta))\Big|_0^{\pi} = \frac{2V_p}{2\pi} = \frac{V_p}{\pi} = .318V_p$$

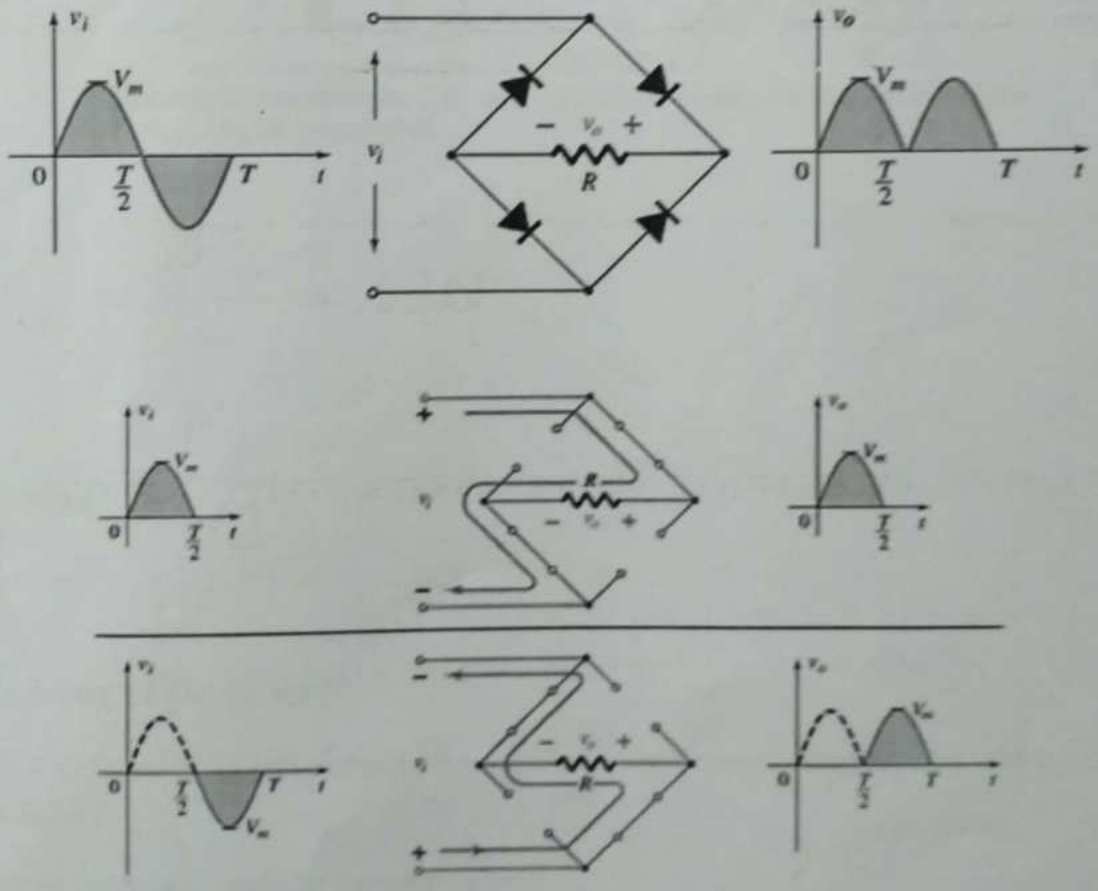
$$V_{rms} = \frac{V_p}{2}$$

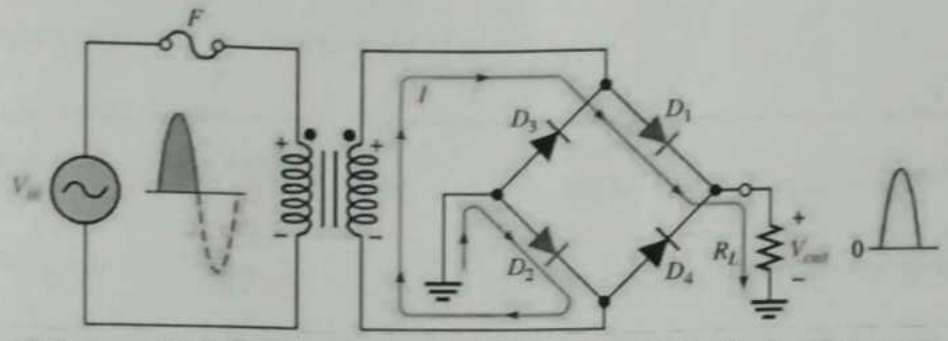
Full-Wave Rectifier

The bridge rectifier

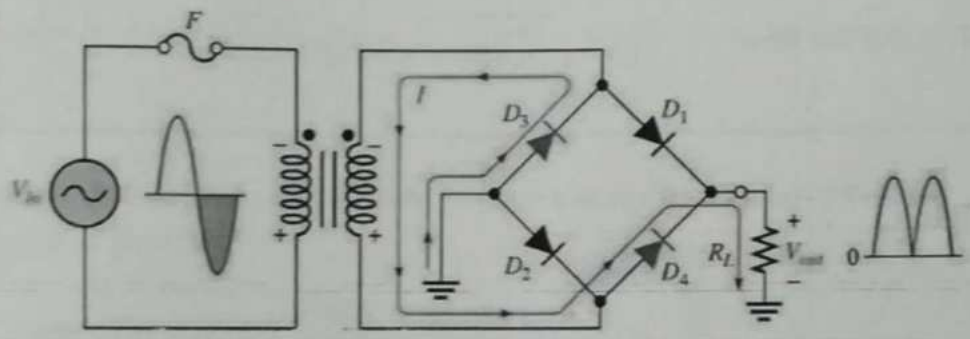
The Bridge rectifier is a circuit, which converts an ac voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the following figure.

The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge. For the positive half cycle of the input ac voltage, diodes D1 and D2 conduct, whereas diodes D3 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance RL and hence the load current flows through RL. For the negative half cycle of the input ac voltage, diodes D3 and D4 conduct whereas, D1 and D2 remain OFF. The conducting diodes D3 and D4 will be in series with the load resistance RL and hence the current flows through RL in the same direction as in the previous half cycle. Thus a bi-directional wave is converted into a unidirectional wave.





(a) During positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased.



(b) During negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

$$V_{av} = \frac{2V_p}{\pi} = .636V_p$$

$$V_{rms} = \frac{V_p}{\sqrt{2}}$$

Reading of Dc meter ?

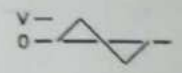
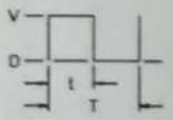
If a D.C. Ammeter is connected in the rectifier output circuit ,what reading will it indicate ?

The dc meter will read the average value .

Reading of AC meter ?

The RMS value will be read , but the AC multimeter is calibrated to read the exact rms value of pure sine wave ,other shape will give incorrect reading .

See the figure bellow to see the amount of error

Waveform Shape	Crest Factor (C.F.)	AC RMS	AC+DC RMS	Average Responding Error
	1.414	$\frac{V}{1.414}$	$\frac{V}{1.414}$	Calibrated for 0 error
	1.732	$\frac{V}{1.732}$	$\frac{V}{1.732}$	−3.9%
	$\sqrt{\frac{T}{t}}$	$\frac{V}{C.F.} \times \sqrt{1-\left(\frac{1}{C.F.}\right)^2}$	$\frac{V}{C.F.}$	−46% for C.F. = 4

Crest Factor is the ratio between the R.M.S. value and the Peak value of the waveform and is given as.

$$\text{Crest Factor} = \frac{\text{Peak value}}{\text{R.M.S. value}}$$

Efficiency of full wave rectifier

$$\begin{aligned}\eta &= \frac{P_{\text{dc}}}{P_{\text{dc}}} \\ &= \left(\frac{V_{\text{dc}}}{V_{\text{rms}}}\right)^2 \times \left(1 + \frac{r_f}{R_L}\right) \\ &\approx 0.8106 \left(1 + \frac{r_f}{R_L}\right) \end{aligned} \tag{31}$$

In reality r_f is much smaller then R_L. If we neglect r_f compare to R_L then the efficiency of the rectifier is maximum. Therefore,

$$\boxed{\eta_{\text{max}} \approx 0.8106 = 81.06\%.} \tag{32}$$

Form factor of full wave rectifier

$$\text{Form factor} = \frac{V_{\text{rms}}}{V_{\text{dc}}} = \frac{\pi}{2\sqrt{2}} \approx 1.11. \tag{33}$$

Peak Inverse Voltage (PIV) of full wave rectifier

Peak inverse voltage(PIV) or peak reverse voltage(PRV) can be defined as the maximum value of the reverse voltage of a diode, which occurs at the peak of the input cycle when the diode is in reverse bias.

PIV of center tapped full wave rectifier is $2V_m$ and of a bridge rectifiers it is V_m.

Peak factor of full wave rectifier

$$\text{Peak factor} = \frac{V_m}{V_{\text{rms}}} = \sqrt{2}. \tag{34}$$

Applications of full wave rectifier

Full wave rectifier is of two types; center tapped and bridge rectifier. Both these rectifiers are used for following purposes depends upon the requirement. Following of full wave rectifier applications are:

- It can be used to detect the amplitude of modulated radio signal.

- It can be used to supply polarized voltage in welding.
- The Bridge Rectifier circuits are widely used in power supply for various appliances, as they are capable of converting the High AC voltage into Low DC voltage.

Advantages of full wave rectifier

- Full wave rectifiers have higher rectifying efficiency than half-wave rectifiers. This means that they convert AC to DC more efficiently.
- They have low power loss because no voltage signal is wasted in the rectification process.
- The output voltage of center tapped full wave rectifier has lower ripples than a half wave rectifiers.

Disadvantages of full wave rectifier

- The center tapped rectifier is more expensive than half-wave rectifier and tends to occupy a lot of space.

A comparison of different parameters related to the half and full wave rectifiers are given below:

Parameters	Half wave rectifier	Full wave rectifier
Number of diodes	1	2 or 4
Maximum efficiency	40.53%	81.06 %
Peak inverse voltage	V_m	V_m or $2V_m$
Average voltage no load	V_m/π	$2V_m/\pi$
V_{rms} no load	$V_m/2$	$V_m/\sqrt{2}$
Ripple factor	1.21	0.48
Form factor	1.57	1.11
Output frequency	f	$2f$

4 RC circuit

An *RC* circuit (also known as an *RC* filter or *RC* network) stands for a resistor-capacitor circuit. An *RC* circuit is defined as an electrical circuit composed of the passive circuit components of a resistor (R) and capacitor (C), driven by a voltage source or current

source. In an RC series circuit, a pure resistor having resistance R in ohms and a pure capacitor of capacitance C in Farads are connected in series.

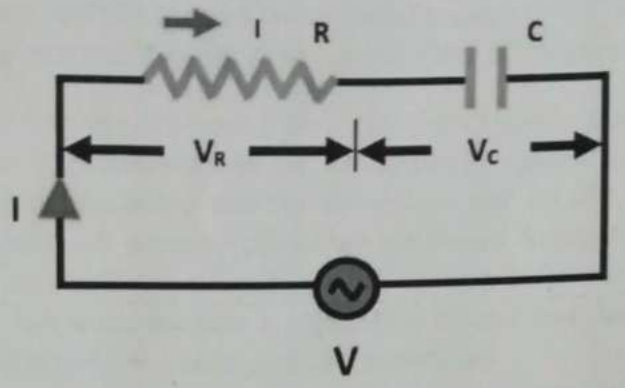


Figure 4: RC circuit diagram [electrical4u.com].

RC time constant

The RC time constant indicates the rate of charge or discharge. RC specifies the time it takes C to charge to 63% of the charging voltage. Similarly, RC specifies the time it takes C to discharge 63% of the way down to the value equal to 37% of the initial voltage across C at the start of discharge.

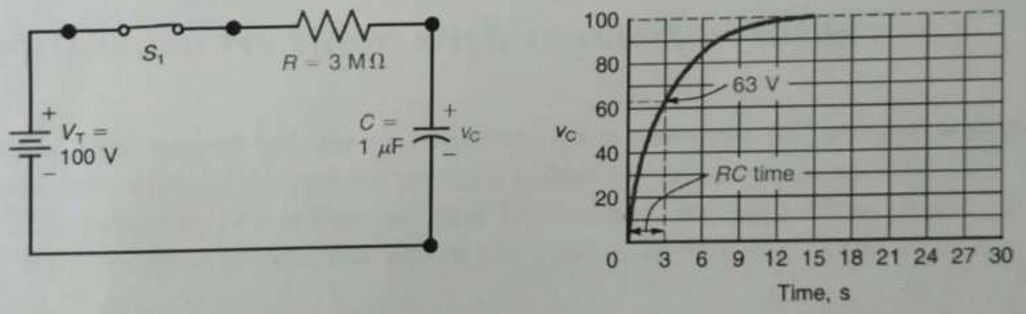


Figure 5: C charges through R to 63% of V_T in one RC time constant.

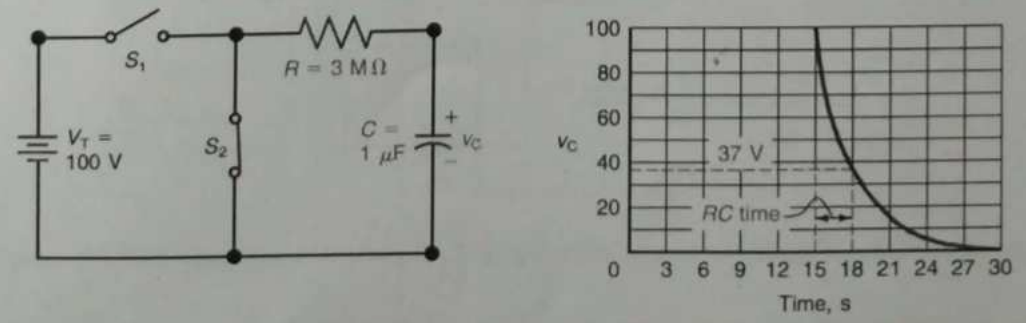


Figure 6: C to discharge through R, V_C drops to 37% of its initial voltage in one time constant.

5 Half wave rectifier with capacitor filter

Filters are components used to convert (smoothen) pulsating DC waveforms into constant DC waveforms. They achieve this by suppressing the DC ripples in the waveform.

Although half-wave rectifiers without filters are theoretically possible, they can not be used for any practical applications. As DC equipment requires a constant waveform, we need to smooth out this pulsating waveform for it to be any use in the real world. This is why in reality we use half wave rectifiers with a filter. A capacitor or an inductor can be used as a filter – but half wave rectifier with capacitor filter is most commonly used. The circuit diagram below shows how a capacitive filter is can be used to smoothen out a pulsating DC waveform into a constant DC waveform.

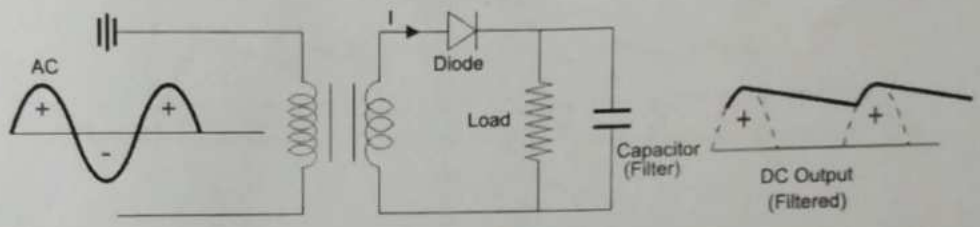


Figure 7: Half wave rectifier with capacitor filter and waveform [electrical4u.com].

6 Full wave rectifier with capacitor filter

With the center tapped full wave rectifier we get a pulsating DC voltage with a lot of ripples as the output. We cannot use this pulsating for practical applications. So, to convert the pulsating DC voltage to pure DC voltage, we use a filter circuit as shown above. Here we place a capacitor across the load. The working of the capacitive filter

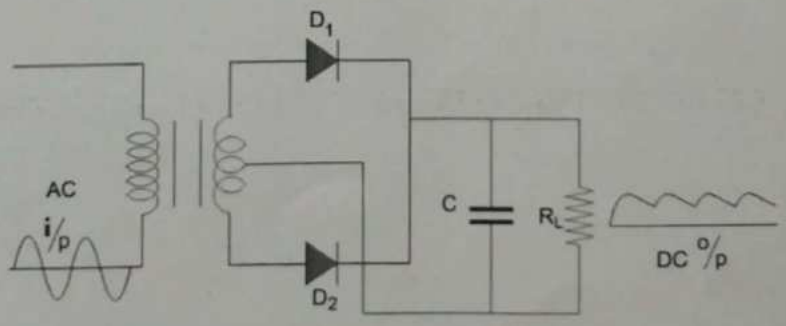


Figure 8: Full wave rectifier circuit diagram with capacitor filter [electrical4u.com].

circuit is to short the ripples and block the DC component so that it flows through another path and is available across the load. During the positive half-wave, the diode D_1 starts conducting. The capacitor is uncharged, and when we apply an input AC voltage which happens to be more than the capacitor voltage, it charges the capacitor immediately to

the maximum value of the input voltage. At this point, the supply voltage is equal to capacitor voltage.

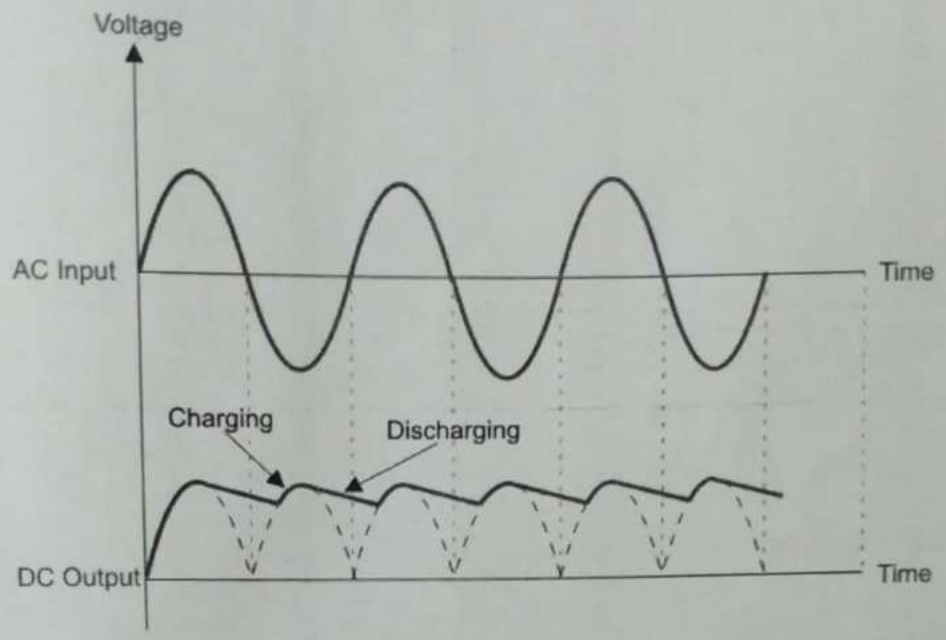


Figure 9: Waveform of full wave rectifier *RC* filter [electrical4u.com].

When the applied AC voltage starts decreasing and less than the capacitor, the capacitor starts discharging slowly but this is slower when compared to the charging of the capacitor and it does not get enough time to discharge entirely and the charging starts again. So around half of the charge present in the capacitor gets discharged. During the negative cycle, the diode D_2 starts conducting, and the above process happens again. This will cause the current to flow through the same direction across the load.

महात्मा गांधी कला विज्ञान
आरमोरी

SKILL ENHANCEMENT COURSE

Affiliated to

GONDWANA UNIVERSITY , GADCHIROLI

Department of PHYSICS

B.Sc. III Year SEM V

Topic Name : Basic Gates and Varification of Truth Table

Session : 2023-2024

Head of Department : Prof. S.B.Gedam

Guided by: Prof. Dr. C.D.Mungmode

14/10/23

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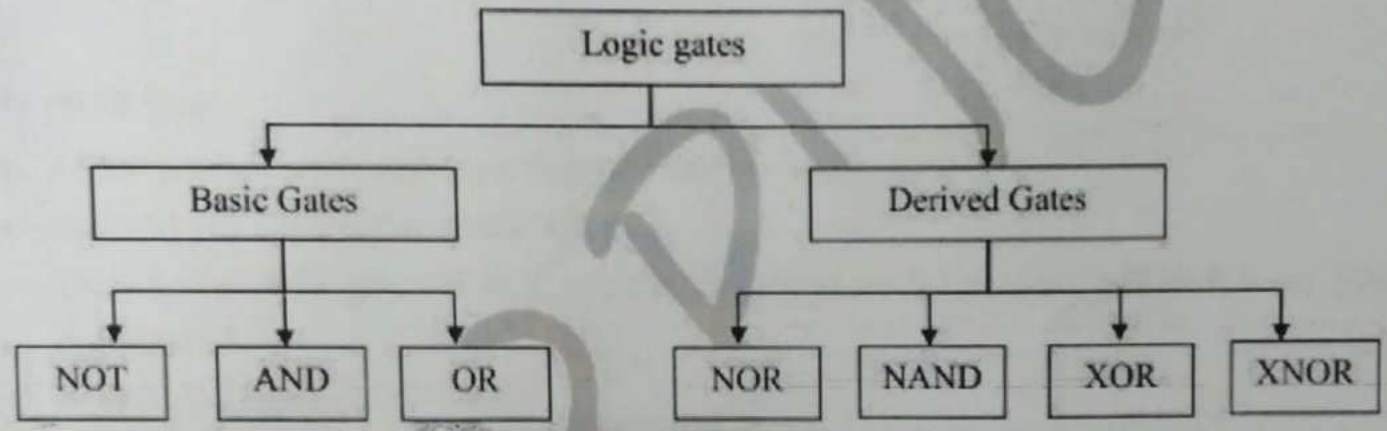
5	Shivani R. Gajpure	S. R. Gajpure

Chapter-3

LOGIC GATES

➢ Introduction:

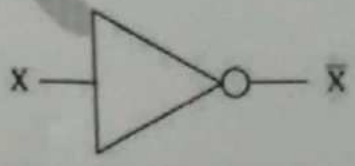
- Gate: ***A Gate is a simply an electronic circuit which operates on one or more input signals and always produces an output signal.***
- Gates are digital (two state) circuits because the input and output signals are either low voltage (0) or high voltage (1).
- Gates are often called logic circuits because they can be analyzed with Boolean algebra.
- Gates are classified into two types:



➢ Basic Gates:

➢ NOT Gate:

- A NOT gate has only one input and one output.
- The output state is always the opposite of the input state.
- A NOT Gate is also called as ***Inverter*** gate, because the output is not same as the input.
- The output is sometimes called the complement (opposite) of the input.
- The logical symbol and the truth table of NOT gate are given below.



X	
0	1
1	0

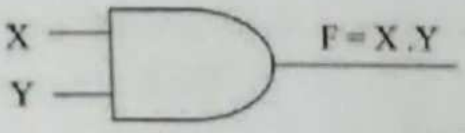
➢ OR Gate:

- A OR gate has two or more input signal but only one output signal.
- If any of the input signals is 1 (high), then the output is 1 (high).
- The logical symbol for two-input OR gate and the truth table is given below.

X	Y	F = X+Y
0	0	0
0	1	1
1	0	1
1	1	1

➢ AND Gate:

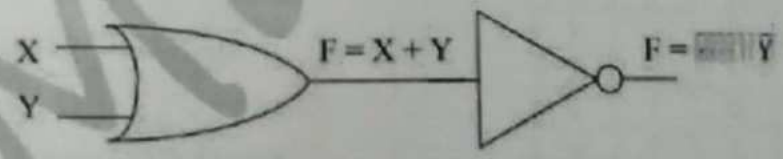
- A AND gate has two or more input signal but only one output signal.
- When all the input signals are 1 (high), the output is 1 (high), otherwise the output is 0.
- The logical symbol for two-input AND gate and the truth table is given below.



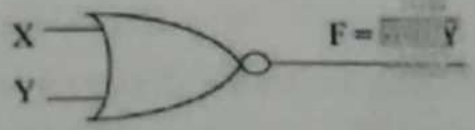
X	Y	F = X.Y
0	0	0
0	1	0
1	0	0
1	1	1

➢ NOR Gate:

- A NOR gate has two or more input signal but only one output signal.
- The NOR gate is a complemented of OR gate.
- The output of NOR gate will be 1 only when all inputs are 0 and output will be 0 if any input represents a 1.
- NOR is short form of NOT-OR
- The symbol ↓ is used to represent a NOR operation. So $\overline{X+Y}$ can be written as X NOR Y or X ↓ Y.
- The logical structure shows an OR gate and NOT gate. For input X and Y, the output of the OR gate will be X+Y which is fed as input to the NOT gate. So the output of NOR gate is given by $\overline{X+Y}$ which is equal to $\overline{X} . \overline{Y}$



- The logical symbol for two-input NOR gate and the truth table given below.



X	Y	F = $\overline{X+Y}$
0	0	1
0	1	0
1	0	0
1	1	0

X	Y	Z	F = $\overline{X+Y+Z}$
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

NAND Gate:

A NAND gate has two or more input signal but only one output signal.

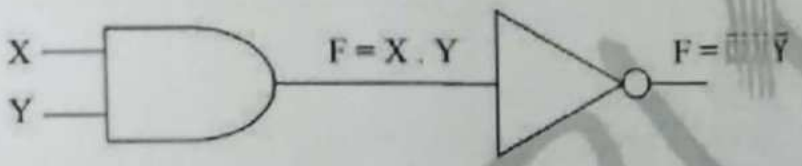
The NAND gate is a complemented of AND gate.

The output of NAND gate will be 0 only when all inputs are 1 and output will be 0 if any input represents a 0.

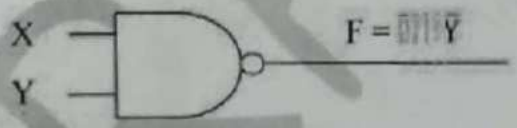
NAND is short form of NOT-AND.

The symbol ↑ is used to represent a NOR operation. So $\overline{X.Y}$ can be written as X NAND Y or X ↑ Y.

The logical structure shows an AND gate and NOT gate. For input X and Y, the output of the OR gate will be X .Y which is fed as input to the NOT gate. So the output of NAND gate is given by $\overline{X.Y}$ which is equal to $\overline{X} + \overline{Y}$



- The logical symbol for two-input NAND gate and the truth table is given below.



X	Y	F =
0	0	1
0	1	1
1	0	1
1	1	0

X	Y	Z	F =
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

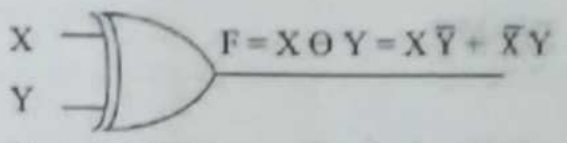
➢ XOR (Exclusive-OR) Gate:

- An exclusive-OR has two or more input signal but only one output signal.
- Exclusive-OR gate is different form of OR gate.
- Exclusive-OR gate produces output 1 for only those input combinations that have odd number of 1's.
- The output is 0 if there are even number of 1's in the input.
- The output is 1 if there are odd number of 1's in the input.
- In Boolean algebra, Θ sign stands for XOR operation. Thus X XOR Y can be written as XΘY
- If the output is given by:

$$F = X \Theta Y$$

$$F = X\overline{Y} + \overline{X}Y$$

- The XOR gate has a symbol similar to OR gate, except the additional curved line of the input side.



- The following truth table illustrates XOR operation for 2 and 3 inputs.

Number Of 1's	Input		Output
	X	Y	F = X ⊙ Y
EVEN	0	0	0
ODD	0	1	1
ODD	1	0	1
EVEN	1	1	0

Number of 1's	X	Y	Z	F = X ⊙ Y ⊙ Z
EVEN	0	0	0	0
ODD	0	0	1	1
ODD	0	1	0	1
EVEN	0	1	1	0
ODD	1	0	0	1
EVEN	1	0	1	0
EVEN	1	1	0	0
ODD	1	1	1	1

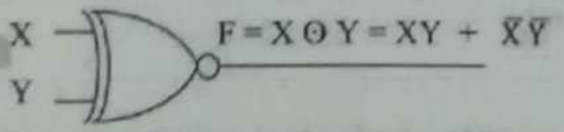
➢ XNOR (Exclusive-NOR) Gate:

- The XNOR gate is complement of XOR gate.
- The output of XNOR is 1 only when the logic values of both X and Y is same i.e. either both are equal to 1 or both are 0.
- Its output is 0 when its inputs are different.
- In Boolean algebra, ⊙ sign stands for XNOR operation. Thus X XNOR Y can be written as X ⊙ Y
- If the output is given by:

$$F = X \odot Y$$

$$F = XY + \overline{X}\,\overline{Y}$$

- The XNOR gate has a symbol similar to NOR gate, except the additional curved line of the input side.



- The following truth table illustrates XOR operation for 2 and 3 inputs.

Number Of 1's	Input		Output
	X	Y	F = X ⊙ Y
EVEN	0	0	1
ODD	0	1	0
ODD	1	0	0
EVEN	1	1	1

Number of 1's	X	Y	Z	F = X ⊙ Y ⊙ Z
EVEN	0	0	0	1
ODD	0	0	1	0
ODD	0	1	0	0
EVEN	0	1	1	1
ODD	1	0	0	0
EVEN	1	0	1	1
EVEN	1	1	0	1
ODD	1	1	1	0

Universal Gate (NAND & NOR):

Universal gate is a gate using which all the basic gates can be designed.

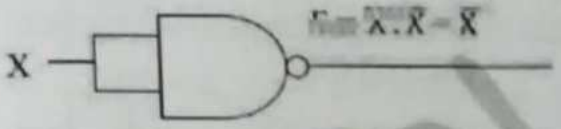
NAND and NOR gate re called as Universal Gates, because all the Boolean functions can also be implemented using these two gates.

NAND and NOR gates are more popular as these are less expensive and easier to design.

Realization of all basic gates using NAND gate:

NAND to NOT:

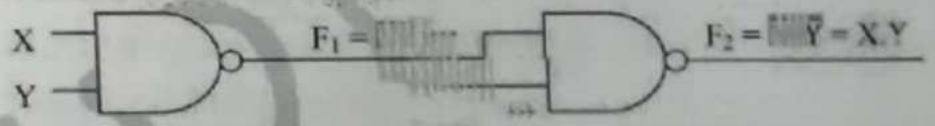
- In the figure we have two input NAND gate whose inputs are purposely connected together so that the same input is applied to both.



- From the diagram X NAND X = $\overline{X.X}$
  = $\overline{X} + \overline{X}$ // DeMorgan's 2nd Theorem
  = $\overline{X}$ $\overline{X} + \overline{X} = \overline{X}$
  = Inverted Input = NOT gate

NAND to AND:

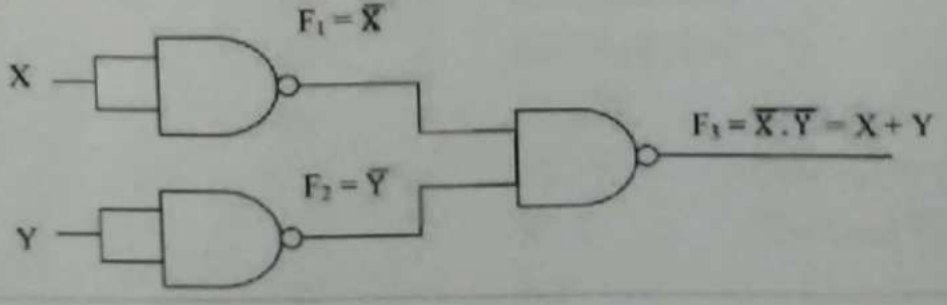
- In the figure we have two NAND gates connected so that the AND operations is performed.
- NAND gate 2 is used as a NOT gate.



- From the diagram X NAND Y =F1= $\overline{XY}$
  F2 = $\overline{X.F1}$
  = $\overline{X} + \overline{F1}$ // DeMorgan's 2nd Theorem
  = $\overline{Y}$ $\overline{X} + \overline{X} = \overline{X}$
  F2 = $X.Y$
  = AND gate

NAND to OR:

- The OR operation can be implemented using NAND gates connected as shown in figure.
- NAND gate 1 and NAND gate 2 are used as NOT to invert the inputs.



From the diagram X NAND Y

$F_1 = \overline{X} + \overline{X} = \overline{X}$

$F_2 = \overline{Y} + \overline{Y} = \overline{Y}$

$F_3 = \overline{F1 . F2}$

$= \overline{F1} + \overline{F2}$ // DeMorgan's 2nd Theorem

$= \overline{\overline{X}} + \overline{\overline{Y}}$ $\overline{\overline{X}} = X$ and $\overline{\overline{Y}} = Y$

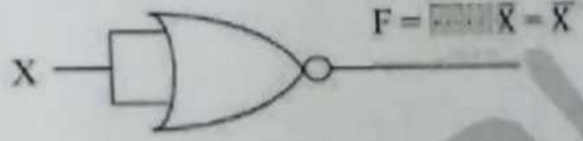
$F_3 = X + Y$

= OR gate

Realization of all basic gates using NOR gate:

NOR to NOT:

Figure shows that NOR gate with its inputs connected together behaves as a NOT gate.



- From the diagram X NOR X

$= \overline{X + X}$

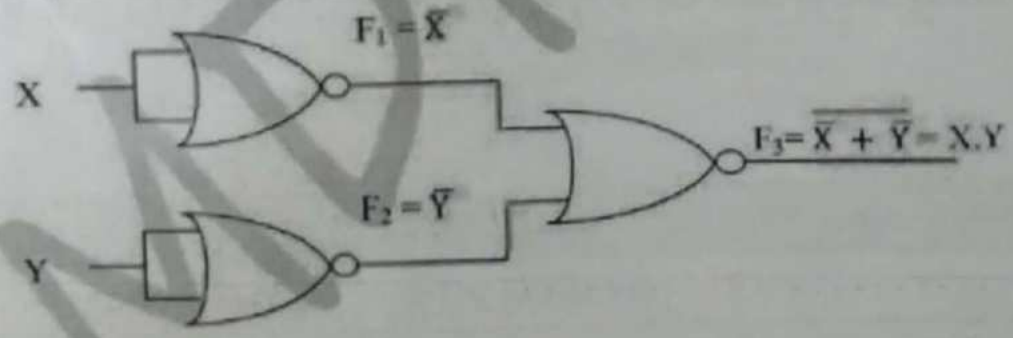
$= \overline{X} . \overline{X}$ // DeMorgan's 1st Theorem

$= \overline{X}$ $\overline{X} . \overline{X} = \overline{X}$

= Inverted Input = NOT gate

NOR to AND:

- The AND operation can be implemented with NOR gate as shown in figure. Here NOR gate 1 and NOR gate 2 are used as NOT gate to invert inputs.



- From the diagram X NOR Y

$F_1 = \overline{X} . \overline{X} = \overline{X}$

$F_2 = \overline{Y} . \overline{Y} = \overline{Y}$

$F_3 = \overline{F1 + F2}$

$= \overline{F1} . \overline{F2}$ // DeMorgan's 1st Theorem

$= \overline{\overline{X}} . \overline{\overline{Y}}$ $\overline{\overline{X}} = X$ and $\overline{\overline{Y}} = Y$

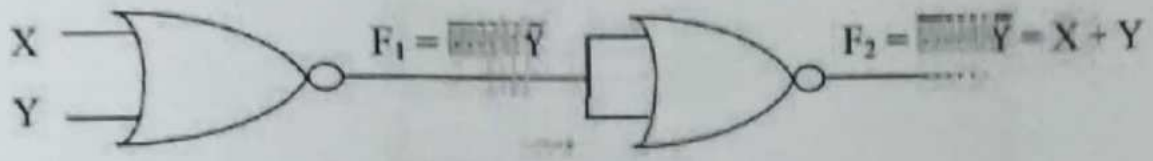
$F_3 = X.Y$

= AND gate

NAND to OR:

In the figure two NOR gates are arranged so that the OR operation is performed.

NOR gate 2 is used as NOT gate.



From the diagram X NOR Y

$F_1 = \quad +$

$F_2 = \quad + F1$

$F_2 = \quad 1$ // DeMorgan's 1st Theorem

$= \quad$

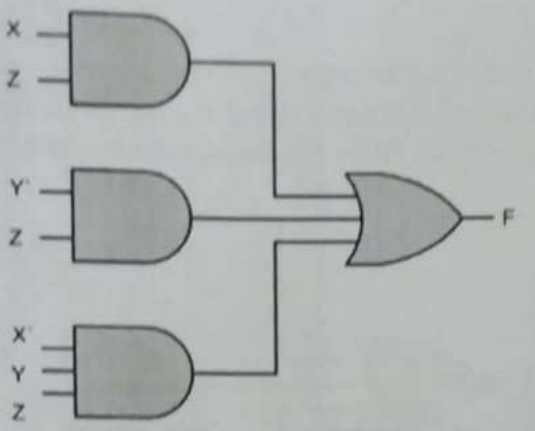
$= \quad \overline{Y}$ $\overline{X} = X$

$F_2 = X + Y$

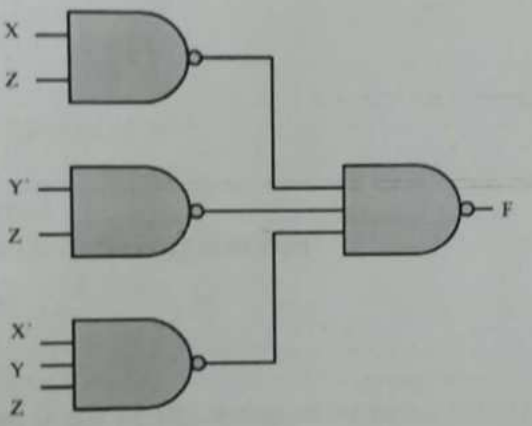
$=$ OR gate

- **Designing of Logic Circuit using all basic gates :**
- **Designing of Logic Circuit using NAND and NOR gates:**

CHAPTER – LOGIC GATES BLUE PRINT			
VSA (1 marks)	LA (3 Marks)	-	Total
01 Question	01 Question	-	02 Questions
Question No 1	Question No 20	-	04 Marks



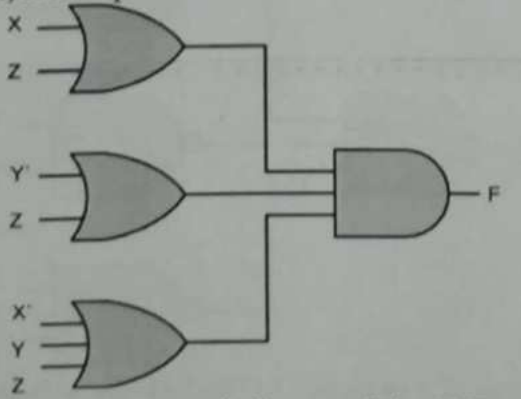
Introducing two successive inverters at the inputs of the OR gate results in the shown equivalent implementation. Since two successive inverters on the same line will not have an overall effect on the logic as it is shown before.
(see animation in authorware version)
By associating one of the inverters with the output of the first level AND gate and the other with the input of the OR gate, it is clear that this implementation is reducible to 2-level implementation where both levels are NAND gates as shown in Figure.



Example 2: Implement the following POS function

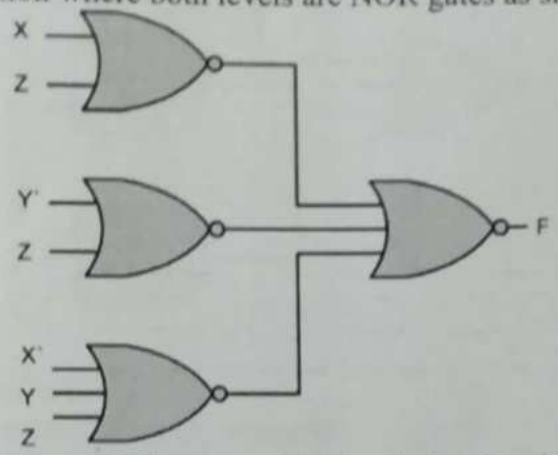
$$F = (X+Z)\,(Y'+Z)\,(X'+Y+Z)$$

Being a POS expression, it is implemented in 2-levels as shown in the figure.



Introducing two successive inverters at the inputs of the AND gate results in the shown equivalent implementation. Since two successive inverters on the same line will not have an overall effect on the logic as it is shown before.

(see animation in authorware version)
By associating one of the inverters with the output of the first level OR gates and the other with the input of the AND gate, it is clear that this implementation is reducible to 2-level implementation where both levels are NOR gates as shown in Figure.



There are some other types of 2-level combinational circuits which are

- NAND-AND
- AND-NOR,
- NOR-OR,
- OR-NAND

These are explained by examples.

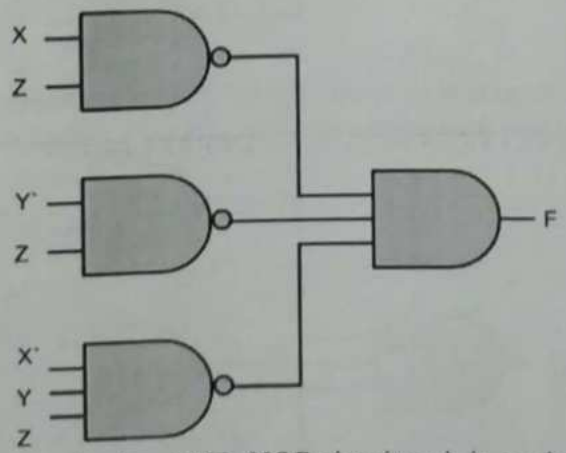
AND-NOR functions:

Example 3: Implement the following function

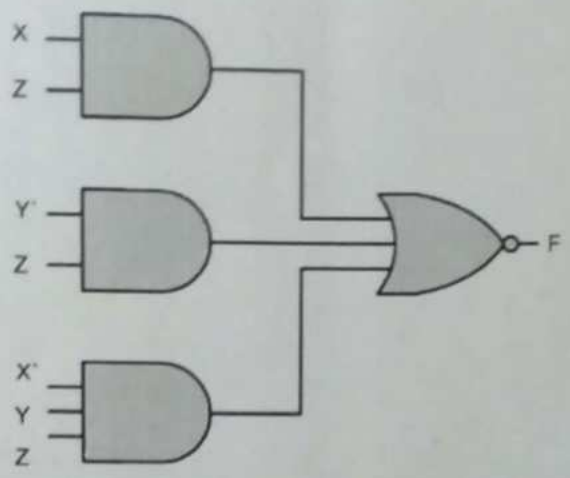
$F = \overline{XZ + \overline{Y}Z + \overline{X}YZ}$ **or**

$\overline{F} = XZ + \overline{Y}Z + \overline{X}YZ$

Since **F'** is in SOP form, it can be implemented by using NAND-NAND circuit. By complementing the output we can get **F**, **or** by using ***NAND-AND*** circuit as shown in the figure.



It can also be implemented using ***AND-NOR*** circuit as it is equivalent to NAND-AND circuit as shown in the figure. (see animation in authorware version)



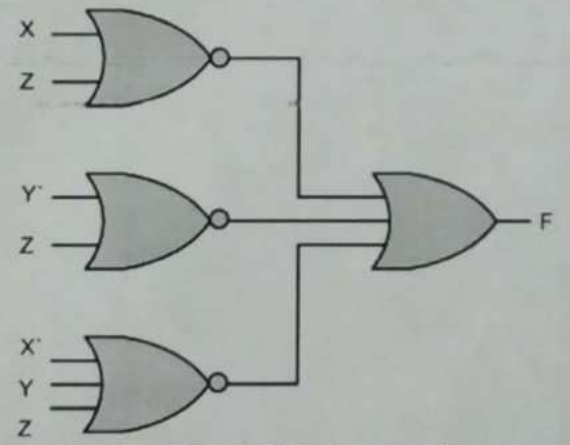
OR-NAND functions:

Example 4: Implement the following function

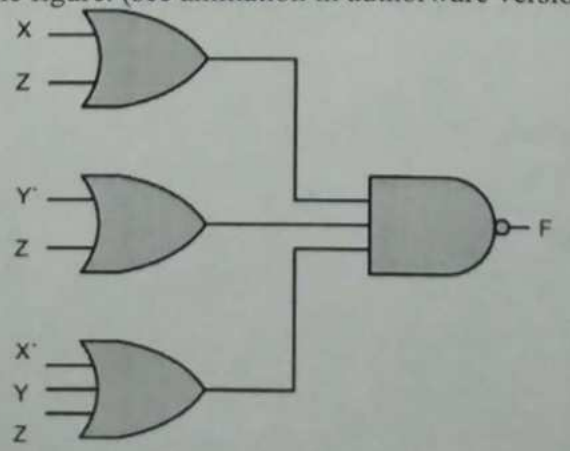
$F = \overline{(X+Z).(\overline{Y}+Z).(\overline{X}+Y+Z)}$ **or**

$\overline{F} = (X+Z)(\overline{Y}+Z)(\overline{X}+Y+Z)$

Since **F'** is in POS form, it can be implemented by using NOR-NOR circuit.
By complementing the output we can get **F**, **or** by using ***NOR-OR*** circuit as shown in the figure.



It can also be implemented using ***OR-NAND*** circuit as it is equivalent to NOR-OR circuit as shown in the figure. (see animation in authorware version)



Manoharbhai Shikshan Prasarak Mandal Armori

Mahatma Gandhi College Arts, Science and Late N.P. Commerce College Armori

Skill Enhancement Course

(Department of Zoology)

BSc. III (Sem-VI)

Session – 2023-24

Topic :-Survey of various vector borne Diseases indexed under the Rural Hospital Wadsa, Dist. Gadchiroli

Guided by:- Prof. S. B. Kumre

(Assistant Professor)

GROUP :- A

Topic:-Survey of various vector borne Diseases indexed under the Rural Hospital Wadsa, Dist. Gadchiroli

STUDENT NAMES :-

1) Shifa mubin khan _____

2) Mahek jahid sheikh _____

3) Sumera shafee sheikh _____

4) Kaniz Ibrahim khan _____

Sr.No.	Student Name	Sign	Photo
1.	Shifa mubin khan		
2.	Mahek jahid sheikh		
3.	Sumera shafee sheikh		
4.	Kaniz Ibrahim khan		

INTRODUCTION:-

Accurate and reliable data collection is crucial for comprehensive healthcare planning and effective public health management. In Wadsa, Dist. Gadchiroli, where access to healthcare services profoundly affects community well-being, conducting a survey on primary health care services is essential. This introduction highlights the importance of such a survey and its potential to enhance healthcare provision in the region.

Wadsa, situated within the Gadchiroli district, epitomizes the rural healthcare hurdles pervasive in numerous Indian regions. Being a remote locale marked by varied socioeconomic profiles, scant infrastructure, and distinct health requirements, comprehending the healthcare scenario via structured data gathering is imperative for bridging current disparities and enhancing health results.

The primary objective of this initial report is to underscore the importance of these surveys, emphasizing their impact on shaping healthcare policies, enhancing service provision, and ultimately boosting the welfare of communities.

The visit was conducted under the guidance of Prof. Sunanda Kumre, department of Zoology, for skill enhancement course (Final year B.Sc. students on 20 March 2023 at Rural Hospital, Wadsa. In the hospital, General as well as specialist treatment are given to out-patients and in- patients. The hospital is run by the Government.

In charge of the hospital, Dr. Avinash Misar and their colleague, along with with Nurses, and Pathologist Miss. Pandit Pawar, guided us on the causes, symptoms, treatment and prevention of various diseases.

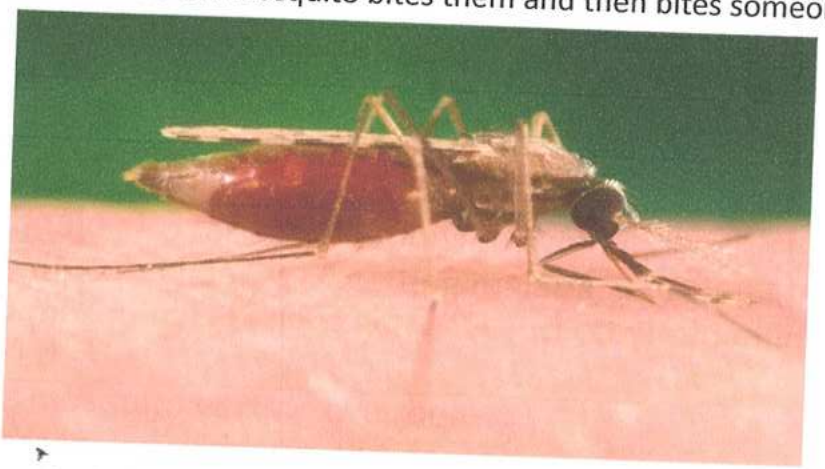
Objectives of the Study:

- The purpose of visit was to identify prevalent health issues and diseases within the community.
- Understand the demographic distribution of health conditions, including age and gender disparities.
- Identify high-risk populations or vulnerable groups disproportionately affected by certain diseases.
- Support advocacy efforts aimed at addressing systemic challenges and improving healthcare access and quality in Wadsa Tehsil Dist. Gadchiroli.
- In this way I have visited Wadsa hospital to know diseases of the Symptoms, Prevention, Treatment etc.
- Doctors and Pathologist told us a lot about disease Causing agents & Diagnosis & and their Causes. In this way we completed Survey project successfully and collected a data.

MALARIA

INTRODUCTION:-

Malaria is a serious disease that spreads when you're bitten by a mosquito infected by tiny parasites. When it bites, the mosquito injects malaria parasites into your bloodstream. Malaria is caused y the parasites, not by a virus or by a type of bacterium.If it isn't treated, malaria can cause severe health problems such as seizures, brain damage, trouble breathing, organ failure and death. The disease is rare in the U.S., with about 2,000 cases per year. If you're traveling to an area where malaria is common, talk to your healthcare provider about ways you can prevent being infected. People who are infected and travel to the U.S. can spread the disease if a mosquito bites them and then bites someone



CAUSES:-

When a mosquito bites someone who has malaria, the mosquito becomes infected. When that mosquito bites someone else, it transfers a parasite to the other person's bloodstream. There, the parasites multiply. There are five types of malaria parasites that can infect humans.
In rare cases, people who are pregnant and who have malaria can transfer the disease to their children before or during birth.It's possible, but unlikely, for malaria to be passed through blood transfusions, organ donations and hypodermic needles.

SYMPTOMS:-

- symptoms of malaria are similar to flu symptoms. They include:
  Fever and sweating.
- Chills that shake your whole body.
  Headache and muscle aches.
  Fatigue.
  Chest pain, breathing problems and cough.
  Diarrhea, nausea and vomiting.
  As malaria gets worse, it can cause anemia and jaundice (yellowing of the skin and whites of the eyes).The most severe form of malaria, which may progress to a coma, is known as cerebral malaria. This type represents about 15% of deaths in children and nearly 20% of adult deaths.

TREATMENT:-

It's important to start treating malaria as soon as possible. Your provider will prescribe medications to kill the malaria parasite. Some parasites are resistant to malaria drugs.Some drugs are given in combination with other drugs. The type of parasite will determine what type of medication you take and how long you take it.
Antimalarial drugs include:
Artemisinin drugs (artemether and artesunate). The best treatment for Plasmodium falciparum malaria, if available, is artemisinin combination therapy.
Atovaquone (Mepron®).
Chloroquine. There are parasites that are resistant to this medication.
Doxycycline (Doxy-100®, Monodox®, Oracea®).
Quinine

Precautions :-

- You should also take precautions to avoid mosquito bites. To lower your chances of getting malaria, you should:
  Apply mosquito repellent with DEET (diethyltoluamide) to exposed skin.
  Drape mosquito netting over beds.
  Put screens on windows and doors.
  Treat clothing, mosquito nets, tents, sleeping bags and other fabrics with an insect repellent called permethrin.
  Wear long pants and long sleeves to cover your skin.

Dengue

•Introduction:-

Engue is a mosquito-borne illness that is common in the tropical and sub-tropica regions of the world, with the common dengue causing fever and flu-like symptoms. However, a more severe form of dengue can result in hemorrhage, internal bleeding, and possible fatality.

All across the globe, there are millions of cases of dengue each year, with tropical regions of the Indian sub-continent.less than half a million cases reported worldwide to over 5 million cases in 2019. And the same WHO report indicates that close to 3.9 billion people today remain in the risk of developing dengue – which is almost half the population of the world.

•Causes:-

Dengue fever is transmitted from one individual to another by mosquito bites of the infected female mosquitoes. The primarily vector of transmission is the Aedes aegypti mosquito. And though the primary mode of transmission is from mosquitoes to humans, maternal transmission from a pregnant mother to the child is also a possibility.

Other causes of dengue include:

Stagnant water, which is a breeding ground for these mosquitoes.

Climate conditions and environmental factor such as high temperatures and humidity

Inadequate mosquito control measures or the absence of effective public health programs

Lack of immunity, making them more susceptible to infection during outbreaks.

•Symptoms:-

Symptoms can vary from mild to severe. Here are some of the common symptoms of dengue according to several medical authorities:

- High fever
- Severe headache
- Pain in the joints
- Muscle pain
- Red spots or bumps on the body
- Nausea and vomitting

Severe forms of dengue may lead to symptoms such as:

- Abdominal pain
- Persistent vomiting
- Bleeding from the nose or gums
- Difficulty breathing
- Restlessness
- Significant decrease in
- blood pressure
- Very thirsty
- Feeling weak
- Pale and cold skin
- Blood in vomit.

•Treatment :-

•Some key components of Treatment for degue:-

1. Stay Hydrated: Dengue can cause dehydration due to high fever, vomiting, and diarrhea.

2. Rest: Get plenty of rest to help your body recover from the infection.

3. Monitoring: Keep a close watch on your symptoms. If they worsen or if you develop severe dengue symptoms, seek medical attention immediately.

4. Medical Care: If you experience severe dengue or dengue hemorrhagic fever, you may require hospitalization.

5. Mosquito Control: Prevent further mosquito bites to avoid the spread of dengue. Use mosquito nets, repellents, and wear long-sleeved clothing.

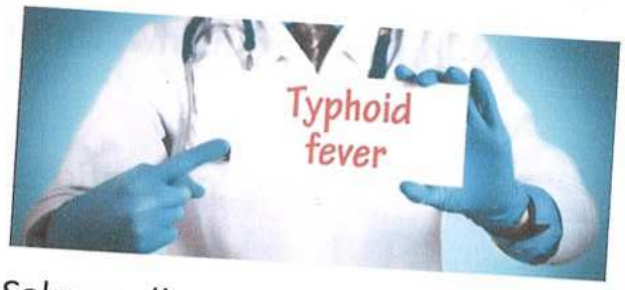
•Precausions:-

- wearing clothes that cover the body
- using mosquito repellents on the body
- using mosquito nets
- using window and door screens
- treating camping gear or clothes with insect repellent before use
- if possible, avoiding being outside at dawn, dusk, and early evening
- remove any stagnant water around the home and avoid camping near still water
- check that drains, plant pots, and other features are not collecting water

Typhoid

•Introduction:-

Typhoid fever is a bacterial infection that can spread throughout the body, affecting many organs. Without prompt treatment, it can cause serious complications and can be fatal.



•Causes:-

A bacteria strain called Salmonella enterica serotype typhi causes typhoid fever. Other strains of salmonella bacteria cause a similar disease called paratyphoid fever.

Typhoid carriers Even after antibiotic treatment, a small number of people who recover from typhoid fever still have the bacteria living in their bodies. These people are known as chronic carriers. They no longer have symptoms of the disease. But they still shed the bacteria in their stools and spread it.

•Symptoms:-

Typhoid fever gets its name from a high fever that can last for weeks if left untreated. It often gets progressively worse over a few days.

Other symptoms of typhoid fever include:

Headache.

Chills.

Loss of appetite.

Stomach (abdominal) pain.

"Rose spots" rash, or faint pink spots, usually on your chest or stomach.

Cough.

Muscle aches.

Nausea, vomiting.

Diarrhea or constipation.

•Treatment :-

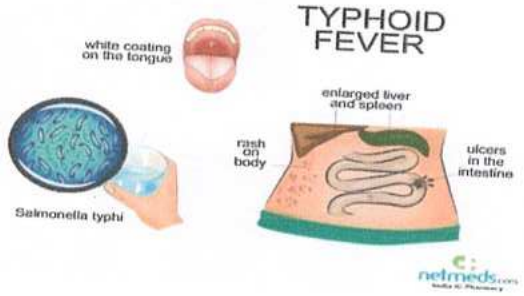
Typhoid is treated with antibiotics. Some newer types of the bacteria are able to survive antibiotic treatments, so you'll be treated with different antibiotics depending on what type of typhoid you have and where you got sick. Paratyphoid fever is also treated with antibiotics.healthcare provider will treat typhoid fever with antibiotics, which may include:

Ciprofloxacin, levoflaxin or ofloxacin.

Ceftriaxone, cefotaxime or cefixime.

Azithromycin.

Carbapenems.



•Precautions:-

Vaccines are the best way to protect yourself from typhoid. But you should also take steps to avoid eating or drinking things that could be contaminated with S. Typhi or other bacteria. This is true both at home and when you're traveling. Safe food handling practices include:

•Don't make food for others if you're sick.

•Wash your hands with soap and water before and after preparing food or eating and after going to the bathroom.

•Wash surfaces and utensils used for food prep and eating before and after use.

•If you're unsure whether the food you're eating is safe, eat mostly well-cooked or packaged food.

•Don't drink untreated water or eat food prepared with untreated water. If you're unsure, it's safest to use bottled water to drink and cook with.

Photo Plate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Longitude: 79.963334
Elevation: 129.31±74 m
Accuracy: 21.1 m
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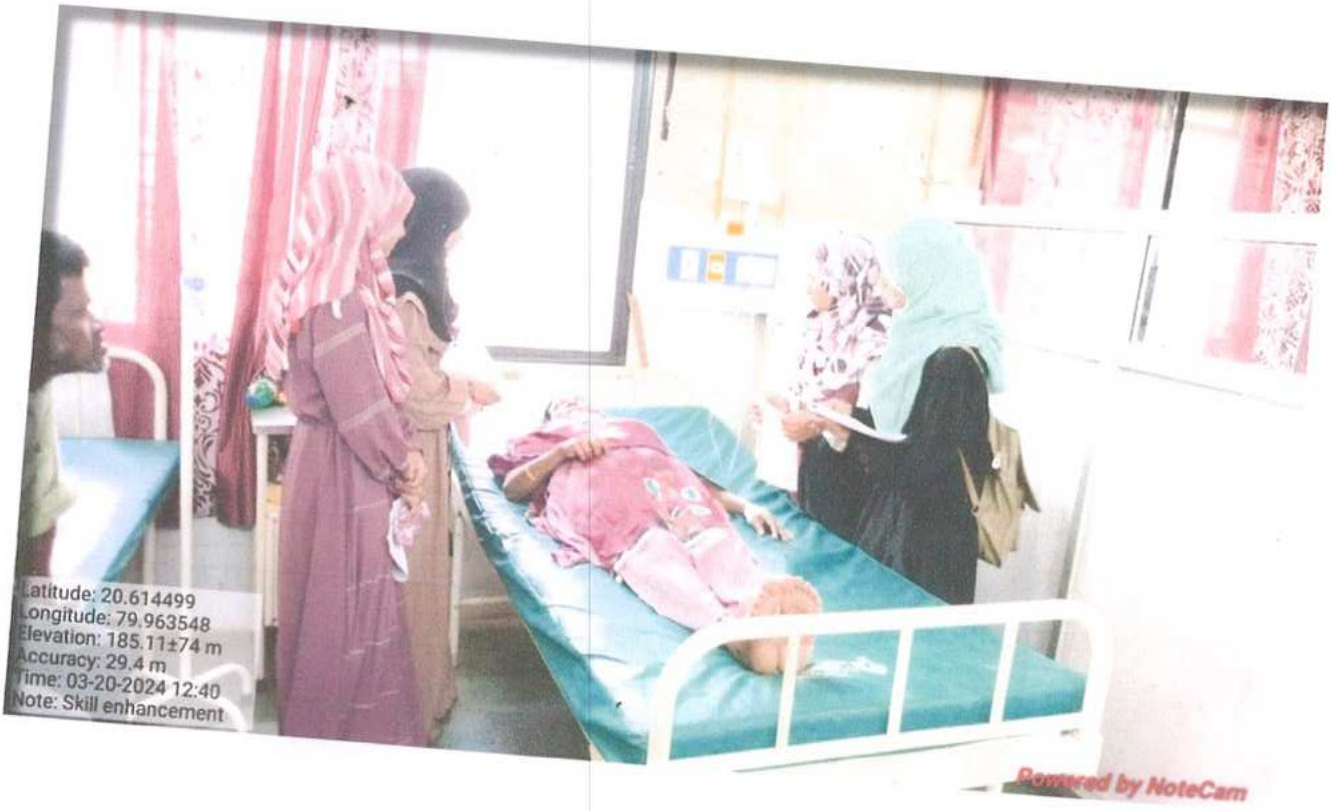
Note: Skill enhancement
Powered by NoteCam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Elevation: 182.81±65 m
Accuracy: 25.1 m
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Note: Skill enhancement

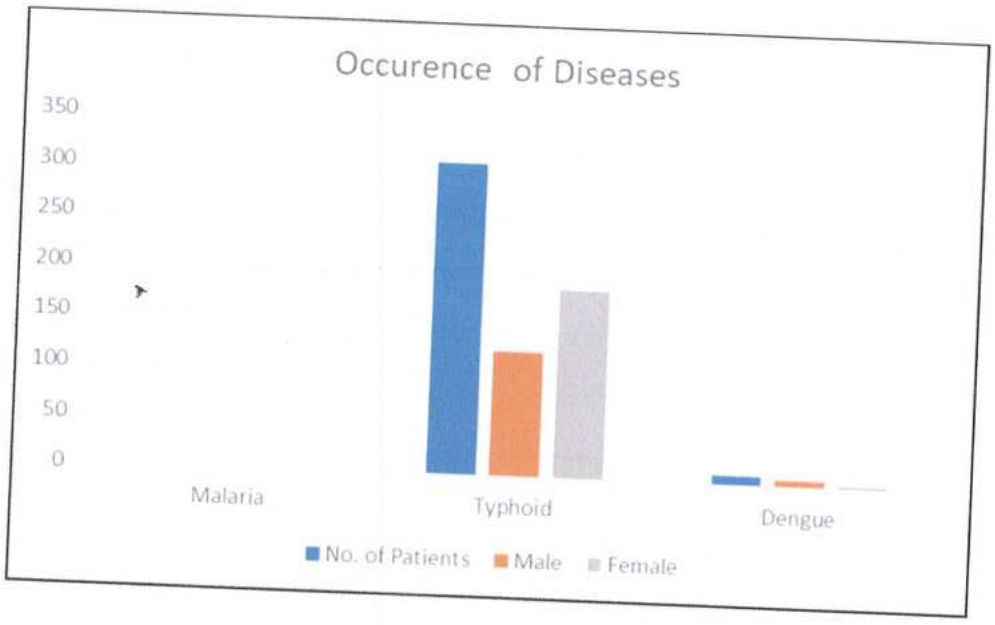

vivo Y75

Observation:

Vector Borne diseases are the illness caused by the vectors. A vector is a carrier of the causative microbe for various diseases such as mosquitoes, ticks and fleas. The reproduction rates of vectors are influenced by climate and weather. Such diseases are widespread and found throughout the world. Eg. Malaria, Dengue, Typhoid etc.

Table 1: Recorded No. of diseases:

Name of Diseases	No. of Patients	Male	Female
Malaria	0	0	0
Typhoid	309	123	186
Dengue	10	7	3



Result: In the survey we collected gender wise data of January 2023 to December 2023, patients suffered from Malaria, typhoid and Dengue diseases.

Discussion: Conducting a data collection survey on Rural Hospital Wadsa, Tah. Wadsa Dist. Gadchiroli is an essential initiative with potentially far-reaching implications for healthcare in the region. It was observed Typhoid patients were more prominently found (n=309) followed by Dengue(n=10), and it was also observed there were no any malarial patients found in Wadsa hospital. So, study was concluded that the proposed study area was more prone for Typhoid and as compare to male, female was more affected (n=186).

Manoharbhai Shikshan Prasarak Mandal Armori

Mahatma Gandhi College Arts, Science and Late N.P. Commerce College Armori

Skill Enhancement Course

(Department of Zoology)

BSc. III (Sem-VI)

Session – 2023-24

Topic:- Survey of medical imaging: Ultrasonogrophy, X-Ray, MRI, CT scan in armori center.

Guided By:- Prof. S.B.Kumre

(Assistant professor)

Group:-A

TOPIC:- Survey of medical imaging: Ultrasonogrophy, X-Ray, MRI, CT scan in armori center.

Student name

Sr. No.	Student name	Signature
1	Payal Anil Bulle	
2	Sonu Parsram Bhoyar	
3	Apurva Ashok Bagmare	
4	Ashutosh Gajanan Mate	

Student Name

Sr. No.	Student Name	Signature	Photo
1.	Payal Anil Bulle	Bulle.	
2.	Sonu Parsram Bhoyar		 28-12-2023
3.	Apurva Ashok Bagmare	Abagmare	
4.	Ashutosh Gajanan Mate		

Introduction

Accurate and reliable data collection is crucial for comprehensive healthcare planning and effective public helth management. In Armori dist. Gadchiroli. Where access to healthcare service is essential. This introduction highlights the important of such surveyand its potential to enhance heathcare provision in the region.

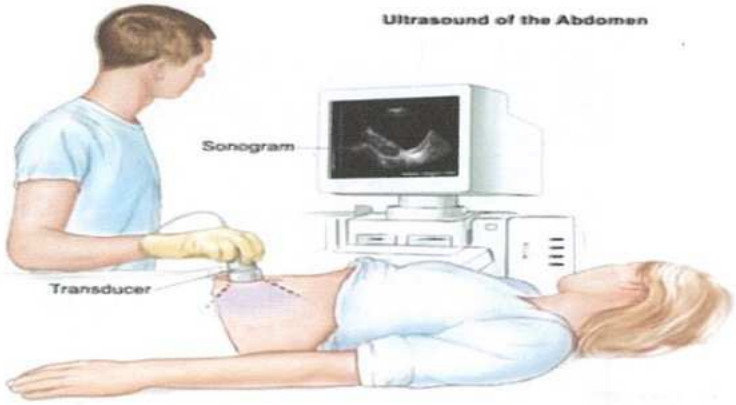
Armori, situated within the Gadchiroli district, epitomize the rural healthcare hurdles pervasive in numerous Indian region. Beinga remote locate marked by varied socioeconomic profiles, scant infrastructure,and distinct helth requirement, comprehending the healthcare scenario via structured data gatheringis imrative for bridgingcurrent disparitiesand enhancing helth result.

The primary objective of this initial report is to underscore the importanceof these surveys, emphasizingtheir impact on shapimghelthcare policies, enhancing service provision, and ultimately boosting the welfare of communities.

The visit was conducted under the guidance of Prof. Sunanda Kumare, Department of Zoology, for skill enhancement course (final year Bsc. Student on 21 march 2024 at sonography center and x-ray center in private hospital in Armori.

In charge of the hospital, for the x-ray Dr. Pillare. Along with Nurses, and there stof. Other in charge of sonography center Dr. Kumbhare And with there stoff for the treatment.

Ultrasonography



Introduction:

Proficiency in ultrasound can be an advantage to a surgeon practicing in a resource- limited setting. Ultrasound performed by the surgeon can give tremendous insight into the patient's disease, especially if more advanced imaging such as CT or MRI aren't immediately available. In this Chapter we explain the principles of Ultrasonography as they relate to you, and we give some basic guidelines for performing ultrasound and interpreting the images. In other chapters, we will discuss Focused Abdominal Sonography for Trauma (FAST) and Ultrasound-Guided Interventions.

Inside the transducer, both forms of the Piezoelectric effect occur. First, the ultrasound waves are generated: electrical energy is applied to the crystal and converted to high frequency soundwaves, which enter enter the tissue below the transducer. These soundwaves interact with thetissue, and then are reflected back towards the transducer at different frequencies, based on the characteristics of the tissue. When these sound waves return, they interact with the same crystal. Here again, mechanical energy is converted to electrical energy, this time containing information about the tissue it has been reflected from. This energy is then converted to an image. The sound waves emitted by the crystal are in the range of 2-10 Megahertz (mHz, millions of cycles per second.) By comparison, human hearing occurs at 20Hz to 20kHz. The tissue below the probe reflects the sound waves differently based on its characteristics. The more dense a tissue is, the more "bright" it appears on the screen. Therefore, the image on the screen is a reflection of the amount of time a sound wave takes. to return to the transducer (depth of the structure) and the strength of the sound wave (brightness of the image.)

Different uses of ultrasonography

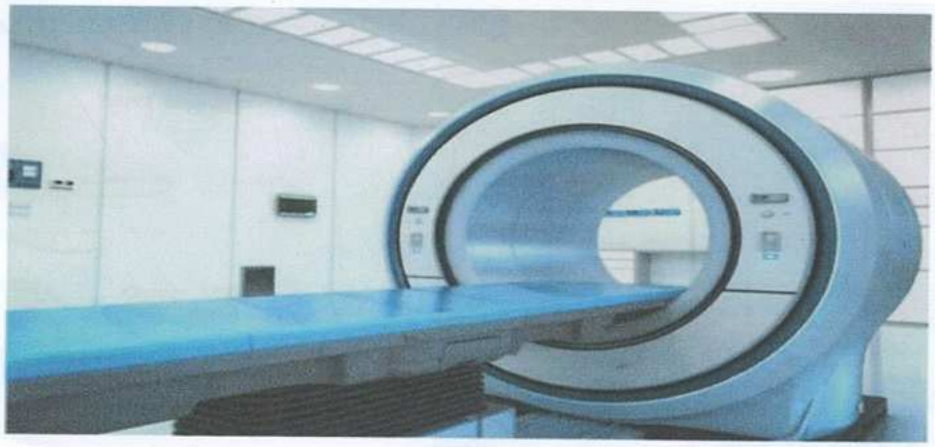
- One of the best known uses for ultrasound imaging is fetal ultrasound, which is used to examine a baby during pregnancy. It's also used to view the ovaries and uterus during pregnancy.
- An abdominal ultrasound examines abdominal tissues and organs.
- Bone sonometry is a type of ultrasound imaging that examines bone density and assesses risk for osteoporosis.
- Breast ultrasound screening can help detect breast cancer in women with dense breasts.

Disadvantages Of Ultrasound

Following are the disadvantages of Ultrasound:

- It has poor penetration through bone or air. Moreover it has limited penetration in obese patients. These are the disadvantages in imaging domain.
- The quality of results and use of equipments depend on skills of operator.
- MRI scan has long imaging times and relatively higher in cost Images can be difficult to interpret and requires experienced operators or radiologists.
- Image resolution is less compare to CT and MRI scan. Air or bowel gas prevents visualization of structures.

MRI- Magnetic resonance imaging



Introduction:

What is MRI?

■ Magnetic resonance imaging (MRI) is a spectroscopic imaging technique used in medical settings to produce images of the inside of the human body.

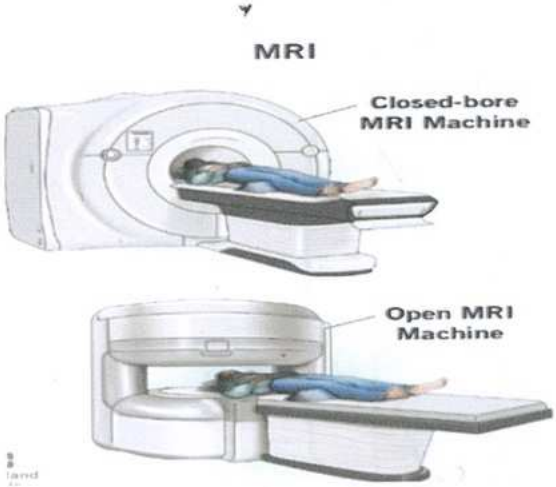
■ MRI is based on the principles of nuclear magnetic resonance (NMR), which is a spectroscopic technique used to obtain microscopic chemical and physical data about molecules

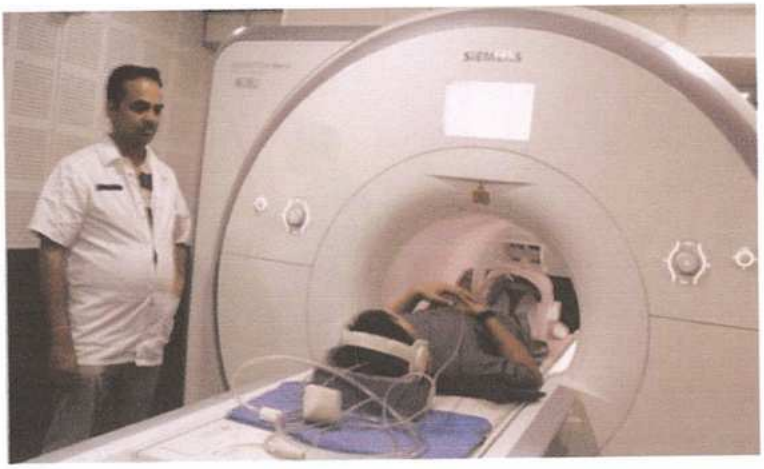
■ In 1977 the first MRI exam was performed on a human being. It took 5 hours to produce one image.

How Does it Work?

■ The magnetic resonance imaging is accomplished through the absorption and emission of energy of the radio frequency (RF) range of the electromagnetic spectrum.

Uses of MRI



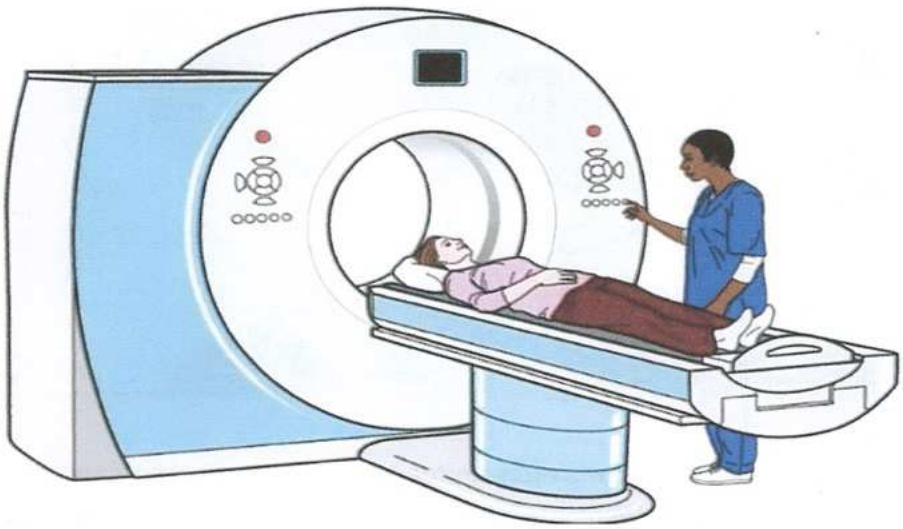


- The following are examples in which an MRI scanner would be used:
- Anomalies of the brain and spinal cord .
- Tumors, cysts, and other anomalies in various parts of the body.
- Breast cancer screening for women who face a high risk of breast cancer.
- Injuries or abnormalities of the joints, such as the back and knee .
- Certain types of heart problems.
- Diseases of the liver and other abdominal organs.
- The evaluation of pelvic pain in women, with causes including fibroids and endometriosis.
- Suspected uterine anomalies in women undergoing evaluation for infertility.

Disadvantages

- Longer scan times
- More expensive
- Machine construction may induce claustrophobia
- Noisier due to RF pulse generation

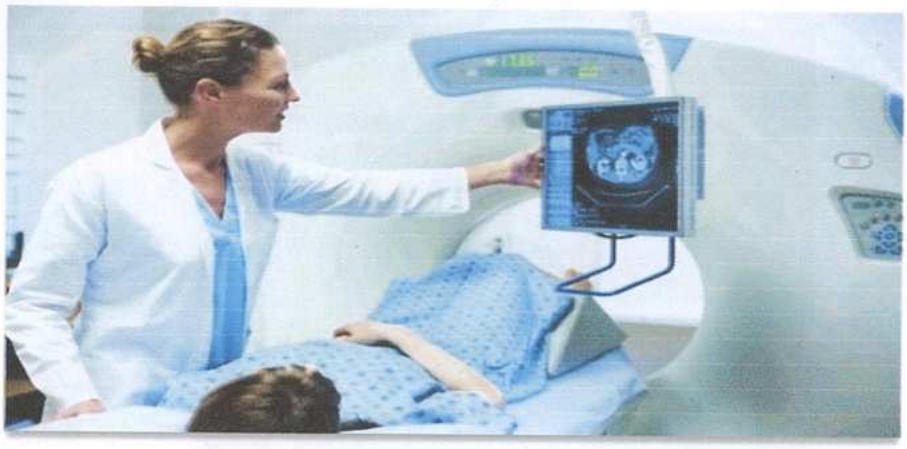
CT scan-Computed Tomography



Introduction

Computed Tomography (CT) scan is also called as Computer axial Tomography (CAT) scan. It provides detailed, cross sectional views of all types of tissues in the human body. Tomography is derived from Greek word "tomos" meaning 'slice' and "graphen" meaning 'to write'. CT scan is one of the best imaging method for analysing the chest, brain and abdomen. It is often used for the diagnosing various cancers like lung, liver and pancreatic cancers. The image reveals to a physician to confirm the presence of a tumour and to measure its size, location and the extent of damage for the near by tissue. It uses special x-ray equipment to obtain a set of image data at different angles around the human body. The set of data processed in a computer to show a cross - section of human body tissues and organs By using CT scan we can produce clear 2-D or 3-D cross sectional images of deep internal organs.

Uses of CT scan



- One of the best and fastest tools for examining the chest, abdomen and pelvic.
- Severe injuries from incidents such as a motor vehicle accident.
- Acute symptoms such as abdominal pain or difficulty breathing . Detecting many different cancers and its size, precise location and the extent of the tumor's involvement with other nearby tissue.
- Detection, diagnosis and treatment of vascular diseases.
- To assess for pulmonary embolism/abdominal aortic aneurysms (AAA). Valuable in diagnosing and treating spinal and cranial problems.

Disadvantages

- Exposure to ionising radiation
- Resolution
- Beam-hardening artifact
- Injection of a contrast medium (dye) can cause kidney problems or result in allergic or injection-site reactions in some people
- Some procedures require anaesthesia

X-rays

Introduction

- X-rays are a type of electromagnetic radiation.
- Other types of electromagnetic radiation are radio waves, microwaves, infrared, visible light, ultraviolet, and gamma rays.
- The types of radiation are distinguished by the amount of energy carried by the individual photons.
- All electromagnetic radiation consists of photons, which are individual packets of energy. For example, a household light bulb emits about 1021 photons of light (non-ionizing radiation) per second.
- The energy carried by individual photons, which is measured in electron volts (eV), is related to the frequency of the radiation.
- Different types of electromagnetic radiation and their typical photon energies are listed in the table on the next slide.

Uses of X-rays

- Used in airports to examine luggage for the presence of dangerous weapons or bombs or for illegal transit of goods.
- used to detect structural deficits or cracks in metal objects such as bridges and aircraft that are likely to be missed by the human eye.
- widely used in medicine to reveal the architecture of the bone and other soft tissues and to find out any abnormality in the form of fracture, growth of tumor.
- also used in dental imaging.
- Used to determine structure of crystalline chemicals.
- Used in the study of space.

Disadvantages Of X-Ray

- Following are the disadvantages of X-Ray:
- It does not provide 3D information.
- Bones can block significant diagnostic data as it absorbs the radiation.
- They do not interact very strongly with lighter elements.
- Due to its radiation, it mutates cells which causes ionisation. This often leads to cancer.
- It does not produce the best image but medium quality image.

Manoharbhai Shikshan Prasarak Mandal Armori

Mahatma Gandhi College Arts, Science and Late N.P. Commerce College Armori

Skill Enhancement Course

(Department of Zoology)

BSc. III (Sem-VI)
Session – 2023-24

Topic :- Survey of Tuberculosis, Hepatitis , Diabetes Diseases indexed under the Sub District Hospital Armori, Dist. Gadchiroli

Guided by:- Prof. S. B. Kumre

GROUP :- B

Topic:- Survey of Tuberculosis, Hepatitis , Diabetes Diseases indexed under the Sub District Hospital Armori, Dist. Gadchiroli

STUDENT NAMES :-

1) Kalyani D. Bhoyar _____

2) Vaishali H. Bagmare V.H.Bagmare.

3) Shivani U. Khewale S.U.Khewale

4) Prachi D. Dhande _____

5) Manjusha R. Madavi _____

Prof. S.B. Kumre
(Asst. Professor)

HEAD
Dept. of Zoology
M. G. College, Armori

Sr.No.	Student Name	Sign	Photo
1.	Kalyani D. Bhoyar		
2.	Vaishali H. Bagmare	V. H. Bagmare	
3.	Shivani U. Khewale	S. U. Khewale	
4.	Prachi D. Dhande	P Dhande	
5.	Manjusha R. Madavi		

Introduction

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Armori, situated within the Gadchiroli district, epitomizes the rural healthcare hurdles pervasive in numerous Indian regions. Being a remote locale marked by varied socioeconomic profiles, scant infrastructure, and distinct health requirements, comprehending the healthcare scenario via structured data gathering is imperative for bridging current disparities and enhancing health results.

The primary objective of this initial report is to underscore the importance of these surveys, emphasizing their impact on shaping healthcare policies, enhancing service provision, and ultimately boosting the welfare of communities.

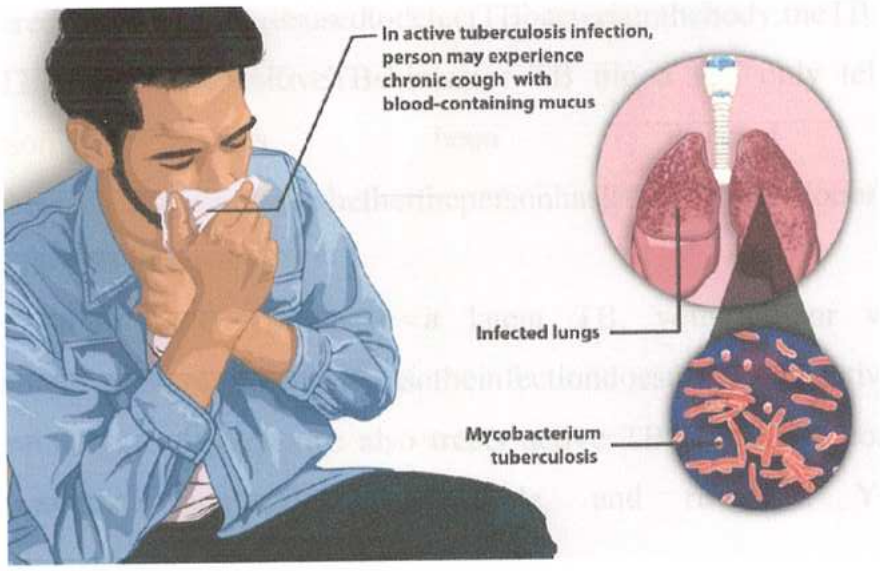
The visit was conducted under the guidance of Prof. Sunanda Kumre, department of Zoology, for skill enhancement course (Final year B.Sc. students on 21 March 2023 at Sub District Hospital,Armori. In the hospital, General as well as specialist treatment are given to out-patients and in- patients. The hospital is run by the Government.

In charge of the hospital, Dr. Raju Koreti and their colleague Dr. Meshram, Dr. Uikey, along with with Nurses, Miss. Anita madam, and Pathologist Miss. Rama Dhoke, guided us on the causes, symptoms, treatment and prevention of various diseases.

Objectives of the Study:

- The purpose of visit was to identify prevalent health issues and diseases within the community.
- Determine the burden of communicable and non-communicable diseases etc.
- Understand the demographic distribution of health conditions, including age and gender disparities.

1) TUBERCULOSIS

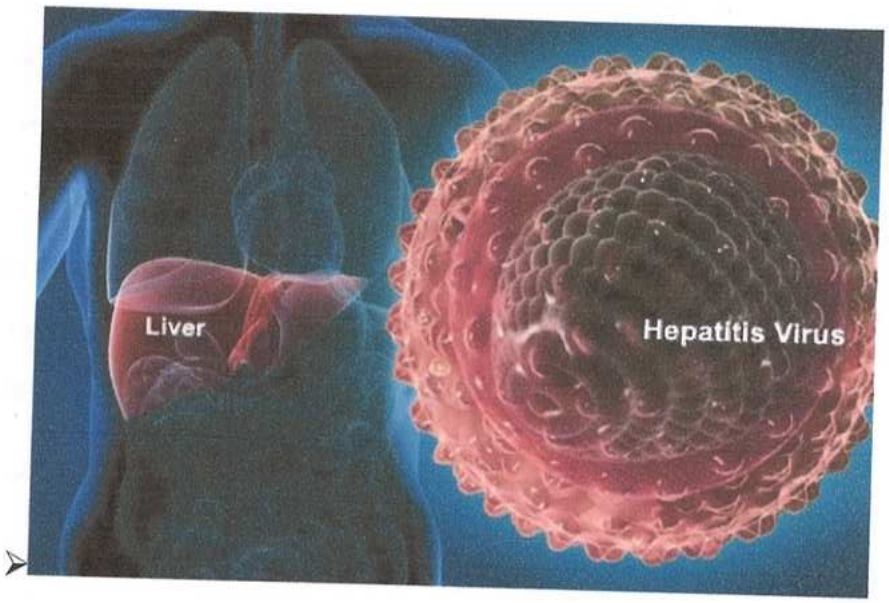


- **Introduction**–Tuberculosisisisaninfectiousdiseasethatprimarilyaffects the lungs parenchyma. It may also be transmitted to otherparts of the body , including the kidneys , bones , lymph nodes . It is aslowlyspreading,chronic,granulomatousbacterialinfection,characterizedb ygradualweightloss.

- **Causes** – Tuberculosis is Caused by a type of Bacterium CalledMycobacterium tuberculosis. The Condition is Spread when a personwithanactiveTBinfectionintheirlung'scoughsorsneezesandsomeonee lseinhalestheexpelleddroplets,whichcontainTBbacteria.

- **Symptoms**–
  - APersistentcoughthatmorethanthreeweeksandusuallybringsupphleg m,whichmaybebloody.
  - Weightsloss
  - Nightsweats
  - HighTemperature(fever)

2) Hepatitis



➢ **Introduction-**

Theword"hepatitis"comesfromtheancientGreekword"hepar" meaning liver and English word "itis" meaning inflammation.TherearehepatitisvirusesA,B,C,DandE,eachofwhichisclassifiedina differentvirusfamily.Itwasoriginallyknowsasserumhepatitis.

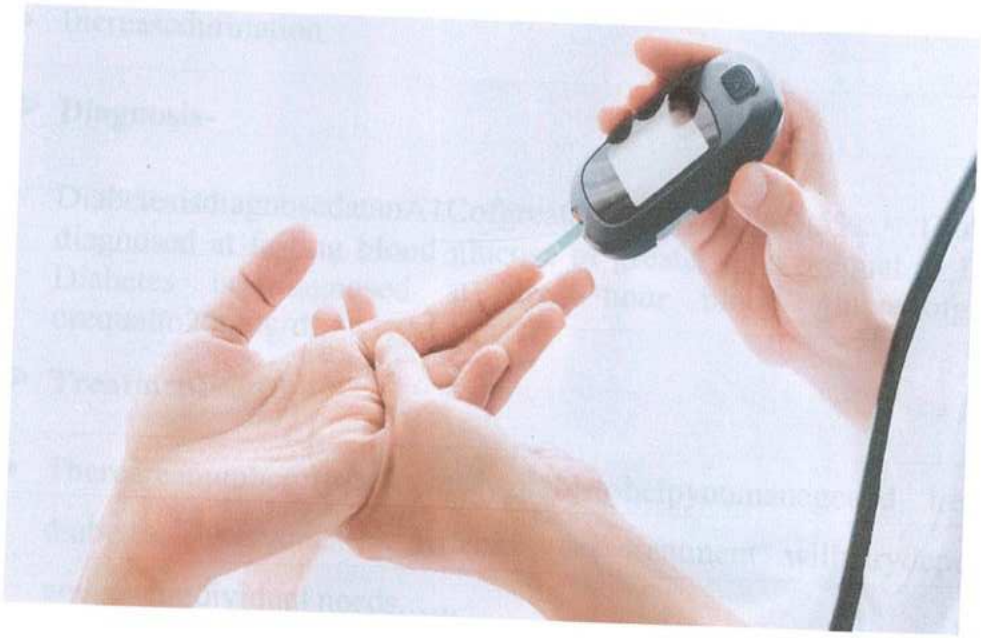
➢ **Causes-**

- Immunecellsinthebodyattackingtheliver.
- Infectionsfromviruses,bacteria,orparasites.
- Liverdamagefromalcoholorpoison.
- Medicines,suchasanoverdoseofacetaminophen.
- Fattyliver.

➢ **Symptoms-**

- Painorbloatinginthebellyarea.
- Darkurineandpaleorclay-coloredstools.
- Fatigue
- Lowgradefever

3) Diabetes



➢ Introduction-

Diabetesisagroupofmetabolicdisorderscharacterizedbyabnormal metabolism, which results most notably in hyperglycemia,due to defects in insulin secretion, insulin action, or both. Diabetes isaseriousdiseaseassociatedwithacuteandchroniccomplications.

➢ Causes-

Genetic, lifestyle and environment can be causes of diabetes.Eating an unhealthy diet, being overweight or obese and not exercisingenough may play a role in developing diabetes, particularly Type 2diabetes.Type1diabetesiscausedbyanautoimmuneresponse.

➢ Symptoms-

- Fatigue
- Blurryversion
- Excessivethirst
- Fruitybreath
- Increasedhunger