

MATHEMATICAL FORMULATION OF A TRANSPORTATION PROBLEM

Let us assume that there are m sources and n destinations. Let a_i be the supply (capacity) at source i , b_j be the demand at destination j , c_{ij} be the unit transportation cost from source i to destination j and x_{ij} be the number of units shifted from source i to destination j .

Then the transportation problem can be expressed mathematically as,

$$\text{Minimize } Z = \sum_{i=1}^m \sum_{j=1}^n c_{ij} x_{ij} \quad \text{subject to the constraints,}$$

$$\sum_{j=1}^n x_{ij} = a_i, \quad i=1, 2, \dots, m$$

$$\sum_{i=1}^m x_{ij} = b_j, \quad j=1, 2, \dots, n$$

$$x_{ij} \geq 0, \quad \forall i, j$$

 GPS Map Camera

Sainthia, West Bengal, India

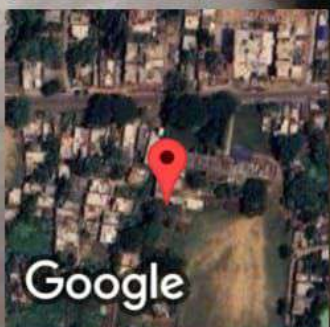
WMXW+F2G, College Rd, near Collage, Muradihi P, Sainthia, West Bengal

731234, India

Lat 23.948634°


Long 87.694723°

04/08/23 01:17 PM GMT +05:30



Google



 GPS Map Camera

Sainthia, West Bengal, India

WMXW+F2G, College Rd, near Collage, Muradihi P, Sainthia, West Bengal

731234, India

Lat 23.948677°

Long 87.694868°

04/08/23 01:52 PM GMT +05:30



Google

Unit-3 : Constraints and their classifications, Lagrange's equation of motion for holonomic system, Gibbs-Appell's principle of least constraint, Work energy relation for constraint forces of shielding friction. **20L**.

Course : BMH6PW01

Project Work (Marks : 75)

Any student may choose Project Work in place of one Discipline Specific Elective (DSE) paper of Semester -VI. Project Work will be done considering any topic on Mathematics and its Applications. The marks distribution of the Project work is 40 Marks for written submission, 20 Marks for Seminar presentation and 15 Marks for Viva-Voce.



ABHEDANANDA MAHAVIDYALAYA

SAINTHIA, BIRBHUM, WEST BENGAL, PIN 731234

Founder: *Srimat Satyananda Dev (1965)*

(Affiliated to the University of Burdwan and Accredited by NAAC)

Phone: 03462263449 E-mail: abhedanandamahavidyalaya@gmail.com Website:

www.abhedanandamahavidyalaya.ac.in

Ref. No.

Date:

COMPLETION CERTIFICATE

This is to certify that the following students of semester VI (Hons.) have successfully completed his/her Project Work under the supervision of **Prof. Chhatu Manuel Mardi**, Department of Mathematics, during the academic year 2023-24.

SI NO	Roll NO	Name of the student	Title of the Project Work
1	210330100017	DIP MONDAL	Game theory and it's application
2	210330100005	AHAMMAD HOSSAIN	"Vam" (linear programming)
3	210330100014	BISWARUP MUKHERJEE	A special case of transportation problem
4	210330100034	RAJLAKSHI CHANDRA	Assignment problem of linear programming
5	210330100035	RUPAK KHANDAIT	Vogel's approx methods

8/26/24
HOD

Department of Mathematics

Dept. of Mathematics
Abhedananda Mahavidyalaya
Sainthia, Birbhum

Sandhanu 26/11/24

Principal

Abhedananda Mahavidyalaya
Sainthia, Birbhum

Principal
Abhedananda Mahavidyalaya
Sainthia, Birbhum



ABHEDANANDA MAHAVIDYALAYA

SAINTHIA, BIRBHUM, WEST BENGAL, PIN 731234

Founder: Srimat Satyananda Dev (1965)

(Affiliated to the University of Burdwan and Accredited by NAAC)

Phone: 03462263449E-mail: abhedanandamahavidyalaya@gmail.com Website:

www.abhedanandamahavidyalaya.ac.in

Ref. No.

Date:

COMPLETION CERTIFICATE

This is to certify that the following students of semester VI (Hons.) have successfully completed his/her Project Work under the supervision of **Dr. Partha Ghosh**, Department of Mathematics, during the academic year 2023-24.

Sl No	Roll No	Name of the student	Title of the Project Work
1.	210330100001	ABDUL HASIM	Ring
2	210330100028	PRANOBENDU ADHIKARI	Ring and it's properties
3	210330100004	ABHISHEK BASAK	Ring theory
4	210330100012	BIKRAM PAL	Graphical method of linear programming

[Signature]

HOD

Department of Mathematics

Dept. of Mathematics
Abhedananda Mahavidyalaya
Sainthia, Birbhum

[Signature]

Principal

Abhedananda Mahavidyalaya

Sainthia, Birbhum

Principal
Abhedananda Mahavidyalaya
Sainthia, Birbhum



ABHEDANANDA MAHAVIDYALAYA

SAINTHIA, BIRBHUM, WEST BENGAL, PIN 731234

Founder: Srimat Satyananda Dev (1965)

(Affiliated to the University of Burdwan and Accredited by NAAC)

Phone: 03462263449 E-mail: abhedanandamahavidyalaya@gmail.com Website:

www.abhedanandamahavidyalaya.ac.in

Ref. No.

Date:

COMPLETION CERTIFICATE

This is to certify that the following students of semester VI (Hons.) have successfully completed his/her Project Work under the supervision of **Dr. Sudipta Senapati**, Department of Mathematics, during the academic year 2023-24.

SI NO	Roll NO	Name of the student	Title of the Project Work
1	210330100008	ANKUR BANDYOPADHYAY	Graphical method of LPP
2	210330100002	ABHIJIT MONDAL	"Simplex method" (linear programming)
3	210330100045	SHAMIT KUMAR MAJHI	Transportation problem: a linear programming approach
4	210330100058	SUJATA GHOSH	Assignment problem of linear programming
5	210330100061	SURAJIT DAS	LPP transportation problem

HOD

Department of Mathematics

Dept. of Mathematics
Abhedananda Mahavidyalaya
Sainthia, Birbhum

Principal

Abhedananda Mahavidyalaya

Sainthia, Birbhum

Principal

Abhedananda Mahavidyalaya
Sainthia, Birbhum



ABHEDANANDA MAHAVIDYALAYA

SAINTHIA, BIRBHUM, WEST BENGAL, PIN 731234

Founder: Srimat Satyananda Dev (1965)

(Affiliated to the University of Burdwan and Accredited by NAAC)

Phone: 03462263449 E-mail: abhedanandamahavidyalaya@gmail.com Website:

www.abhedanandamahavidyalaya.ac.in

Ref. No. _____

Date: _____

COMPLETION CERTIFICATE

This is to certify that the following students of semester VI (Hons.) have successfully completed his/her Project Work under the supervision of **Dr. Surya Kanta Mondal**, Department of Mathematics, during the academic year 2023-24.

SI NO	Roll NO	Name of the student	Title of the Project Work
1	210330100047	SHREYA ROY	Classification of partial differential equation
2	210330100054	SUBHAMOY BHATTACHARYA	Algebraic and transcendental equations
3	210330100060	SUMAN MANDAL	Application of derivatives
4	210330100031	PUJA SAHA	Convolution operation on image processing with the help of matrix

HOD

Department of Mathematics

Depl. of Mathematics
Abhedananda Mahavidyalaya
Sainthia, Birbhum

Principal

Abhedananda Mahavidyalaya

Sainthia, Birbhum
Principal
Abhedananda Mahavidyalaya
Sainthia, Birbhum

THE UNIVERSITY OF BURDWAN



ABHEDANANDA MAHAVIDYALAYA



SEMISTER : VI

NAME: SHAMIT KUMAR MAJHI

UNIVERSITY ROLL NO: - 210330100045

REGISTRATION NO:- 202101026530 of 2021-22

SUBJECT: MATHEMATICS

Under the guidance of Prof Dr. SUDIPTA SENAPATI

A project work presented for the degree of Bachelor of Science

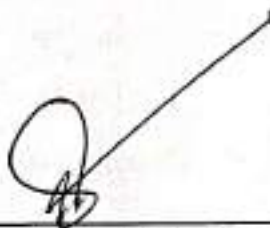
**PROJECT TOPIC: TRANSPORTATION PROBLEM: A LINEAR
PROGRAMMING APPROACH**

TRANSPORTATION PROBLEM: A LINEAR PROGRAMMING APPROACH

Submitted by
SHAMIT KUMAR MAJHI

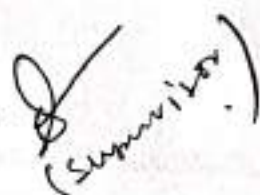
University Roll No: 210330100045

Registration No: 202101026530 of 2021-2022



Associated Professor

Head of Department of Mathematics



(Submitter)

ACKNOWLEDGEMENT

I would like to warmly acknowledge and express my deep sense of gratitude and indebtedness to my guide Dr. Sudipta Senapati and Dr. Partha Ghosh, Department of Mathematics, Abhedananda Mahavidyalaya, whose keep guidance, valuable suggestions and instruction, constant encouragement has served as the major contribution towards the completion of this project.

Also, I would like to thank all of my teacher Surya Kanta Mondal, Chhatu Manuel Mardi for allowing me to work on this project and their co-operation.

Last but not the least I would like to thank my parents, brother and friends for their blessings and inspiration.

Shamit Kumar Majhi
SHAMIT KUMAR MAJHI

Date: 26/07/2024
Sem: VI
Mathematics Honours

CERTIFICATE

This is certify that the project work entitled "Transportation problem: A Linear Programming Approach" is the investigatory project work in mathematics, successfully completed by **SHAMIT KUMAR MAJHI**, student of B.Sc. semester VI (Department Of Mathematics), Abhedananda Mahavidyalaya, under the University Of Burdwan, bearing University Roll No. 210330100045, Registration No: 202101026530 Of 2021-22, under the guidance of Dr. Sudipta Senapati for the partial fulfilment of requirements for the course completion in pursuance.

Date: 26/07/2024



Associate Professor

(Dept. of Mathematics)

CONTENT

Topic	Page No.
Acknowledgement	2
Certificate	3
Objectives	4
Abstract	5
Introduction	6
Mathematical Model of Transportation problem	7-8
General Mathematical Model of Transportation problem	8-9
Method of Finding Initial Basic Feasible Solution	10-32
1) North West Corner Method	10-16
2) Row-minima Method	16-20
3) Column-minima Method	20-25
4) Matrix-minima Method	25-29
5) Vogel's Approximation Method (VAM)	29-32
Optimality Test (U-V Method)	32-40
Unbalanced Transportation problem	41-51
Conclusion	52
References	53-55

OBJECTIVES

After studying this chapter, we should be able to

- 1) Recognize and formulate a transportation problem involving a large number of shipping routes.
- 2) Drive initial feasible solution using several methods.
- 3) Drive optimal solution by using Modified Distribution Method.
- 4) Handle the problem of degenerate and unbalanced transportation problem.
- 5) Examine multiple optimal solutions, and prohibited routes in the transportation problem.
- 6) Construct the initial transportation table for a trans-shipment problem.
- 7) Solve a profit maximization transportation problem using suitable changes in the transportation algorithm.

ABSTRACT

The transportation problem (TP) is a unique kind of Linear Programming Problem (LPP) that handles the division of individual item (finished or raw) from different sources of resource to different destination of need in such a manner that the entire transportation cost is minimized. This project presents the mathematical structure for the transportation problem. It's desirable to decide a transportation schedule which is going to satisfy the foundation availabilities, non-negative restrictions and destination requirements while minimizing the entire cost of transportation. The linear mathematical structure of the transportation problem (MOTP) is a unique sort of linear programming problem where constraints are of uniformity type and the objectives are conflicting with one another. The exciting solution methodology of this problem can be partitioned into two classes. First class consist those that are producing all the sets of effective solution and the second classification speaks to the techniques that are looking for the best compromise solution among the arrangement of proficient solution.

INTRODUCTION

One important application of linear programming is in the area of physical distribution (transportation) of goods and services from several supply centres to several demand centres. A transportation problem when expressed in terms of an LP model can also be solved by the simplex method. However a transportation problem involves a large number of variable and constraints, solving it using simplex methods takes a long time. Transportation algorithms, namely the MODI (modified distribution) Method have been developed for solving a transportation problem.

The structure of transportation problem involves a large number of shipping routes from several supply centres to several demands centres. Thus, objective is to determine shipping routes between supply centres and demand centres in order to satisfy the required quantity of goods or services at each destination centre, with available quantity of goods or services at each supply centre at the minimum transportation cost and/ or time.

The transportation algorithm help to minimize the total cost of transporting a homogeneous commodity (product) from supply centres to demand centres. However, it can also be applied to the maximization of total value of utility.

There are various types of transportation models and the simplest of them was first presented by F L Hitchcock (1941). It was further developed by T C koopmans (1949) and G B Dantzig (1951). Several extensions of transportation models and methods have been subsequently developed.

THE ROLE OF CHEMISTRY TO SOLVE
THE CHALLENGES OF 21st CENTURY

Report Submitted to,
Abhedananda Mahavidyalaya (Department of chemistry)



By

AYAN KARMAKAR (B.Sc Honours, 6th sem)

ROLL NO-210330100010

Reg No- 202101026490 of 2021-22

UNDER THE SUPERVISION OF

DR. TANMAY DAS



ABHEDANANDA MAHAVIDYALAYA

SAINTHIA, BIRBHUM, WEST BENGAL, PIN 731234

Founder: *Sri Sri Sivananda Dev (1965)*

(Affiliated to the University of Burdwan and Accredited by NAAC)
Phone: 03462263449 E-mail: abhedanandamahavidyalaya@gmail.com Website: www.abhedanandamahavidyalaya.ac.in

Date: 15.05.2024

Department of Chemistry

Certificate of Project Completion

This is to certify that Mr. Ayan Karmakar, a student of B.Sc. (Hons.) in Chemistry, 6th Semester, Roll No. 210330100010, Registration No. 202101026490 of 2021-22, has successfully completed the project titled: "The role of Chemistry to solve the challenges of 21st Century" under the supervision of Dr. Tanmay Das, Department of Chemistry, Abhedananda Mahavidyalaya, Sainthia, during the academic session 2023-2024.

Tanmay Das
Supervisor
15.05.24

[Signature]
Head
15/05/24

Department of Chemistry

[Signature]

Principal

Principal
Abhedananda Mahavidyalaya
Sainthia, Birbhum

❖ *INTRODUCTION*

Chemistry stand at the forefront of addressing the multifaceted challenges of the 21st century. Playing a pivotal role across diverse sector. From powering our home with renewable energy to developing life saving pharmaceutical, chemistry is the cornerstone of innovation and advancement in today's society. One of the most pressing issues facing humanity is the urgent need for sustainable energy sources to reduce fossil fuel. Chemistry plays important role in this field by driving research and development and renewable energy. Furthermore chemistry is instrumental in addressing environmental challenges such as pollution and waste management, by developing innovative materials and processes. In the realm in healthcare, chemistry is indispensable in the discovery and development of life-saving drugs and treatments.. Chemistry plays a central role in addressing the complex challenges of 21st century.

❖ Climate Change Solutions with Advanced Materials

• Climate change is another critical challenges, and chemistry offers innovative solutions.

• Newer technologies, such as carbon capture and utilization (CCU) (fig.1) are emerging as effective tools.

• Chemistry are developing advanced materials like metal-organic frameworks (MOFs) (fig.2) for efficient CO₂ capture and conversion.

• These materials not only capture CO₂ but also convert them into valuable products like fuels and chemicals.

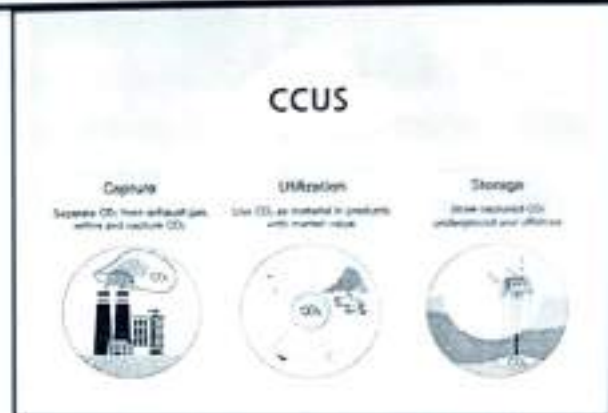
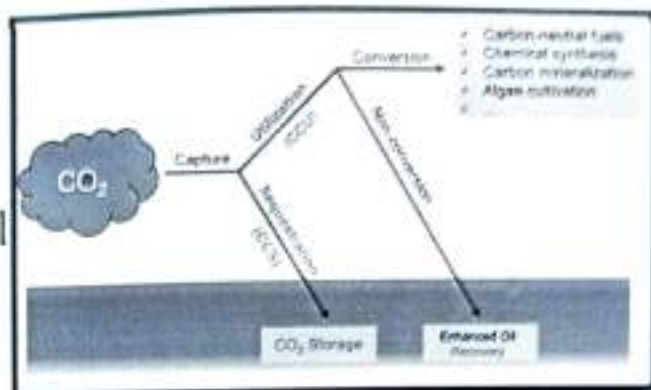


Fig1: -Carbon Capture and Utilization

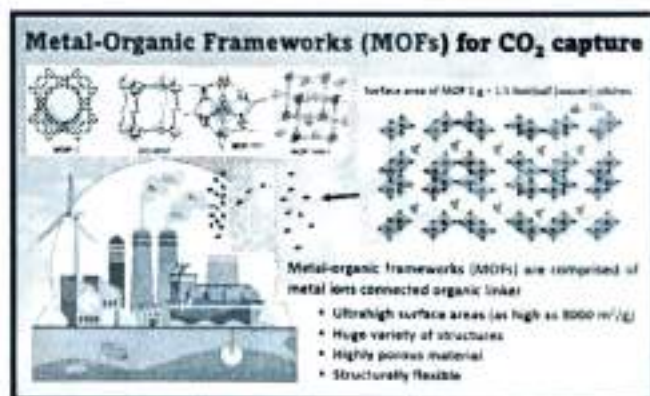
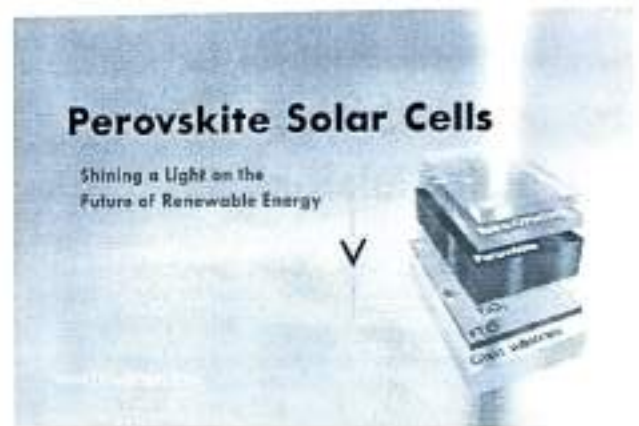
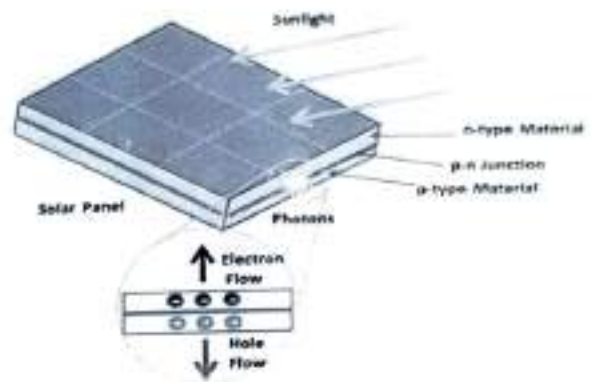


Fig2:- Metal-organic Frameworks(MOFs)



❖ RENEWABLE ENERGY(Solar Power)

- Chemistry plays a vital role in the development of solar cells.
- Photovoltaic cells made of semiconductor materials like silicon, convert sunlight into electricity.
- Thin-film solar cells, perovskite solar cells are emerging technologies that offer higher efficiency.



□ Advantages of Solar Cells

- Inexpensive solar cells using nanoscience would help to preserve environment.
- Fossil fuels use would decrease and thus pollution decrease.
- Even billions of people can help to reduce carbon emission.

❖ELECTRIC VEHICLES (Evs)

•Electric vehicles are becoming increasingly popular as a clean transportation option.

•Chemistry is essential in developing batteries for EVs.

•Lithium-ion batteries(fig.3) are the most common type, with cathode materials like lithium cobalt oxide or lithium iron phosphate.

•Advances in battery chemistry, such as solid-state batteries and lithium-sulfur, offer higher energy density and faster charging.



Fig3:-Lithium ion batteries

Solid-State Lithium-Metal Batteries

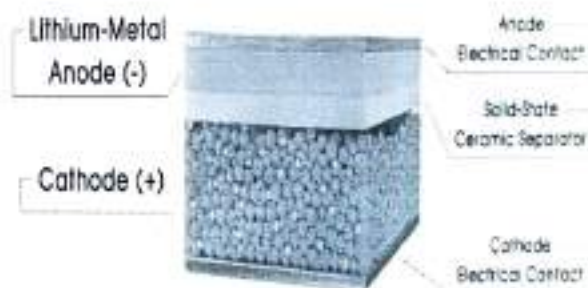
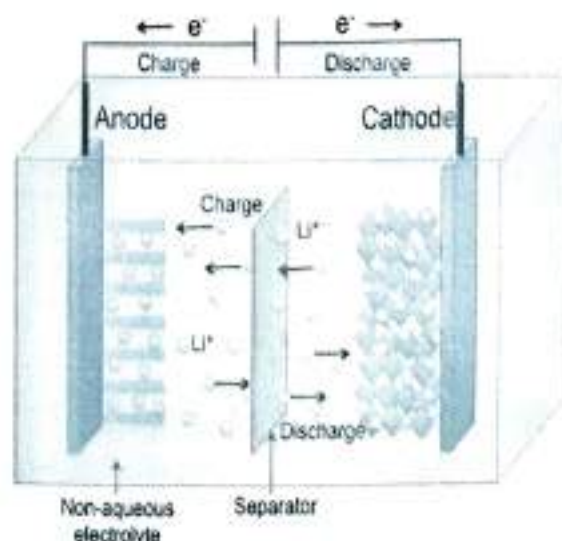


Fig4:- Solid state lithium-metal batteries



❖Chemistry in Medical Field

Chemistry plays crucial role in medical field for developing newer medicines, drugs and vaccines.

•Chemistry in COVID-19 Pandemic

Chemistry played a pivotal role in the development of vaccines(mRNA vaccines, a newer advancement), diagnostic and treatment.

•Chemists also developed antiviral drugs.

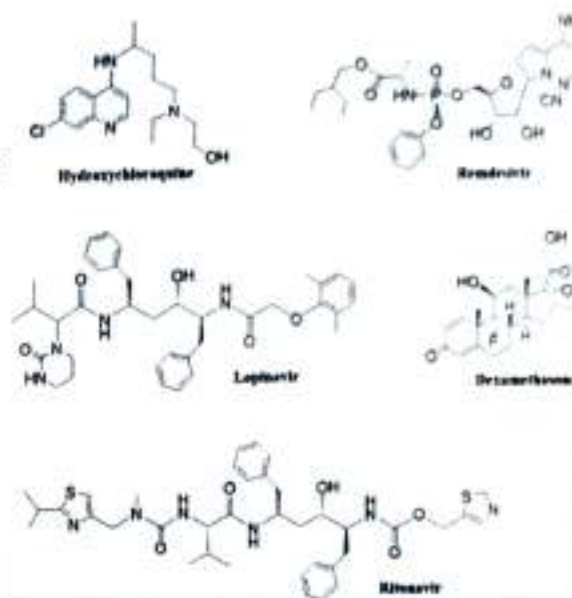
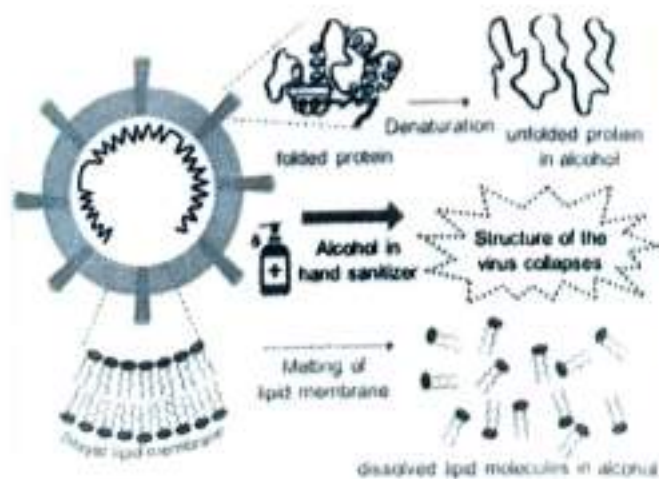


Fig.7:- Chemical structure of therapeutic drugs for COVID-19

•Chemistry enables the production of effective hand sanitizer which is crucial for killings viruses and bacteria.

•Bleach, or sodium hypochlorite, is a powerful disinfectants used to sanitize surface and kill viruses.



❖ Cancer Treatment Breakthroughs

• Cancer remains one of the most challenging diseases of our time.

• Chemistry is revolutionizing cancer treatment with targeted therapies and immunotherapies.

• One of the most well-known anticancer drug is Cisplatin(fig). Which is use to in chemotherapy to treat various cancers.

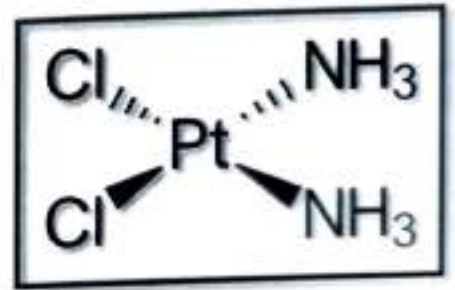


Fig.8:- Cisplatin

• Ruthenium-based compound have shown potential in cancer therapy.

• These compounds can absorb light, leading to generation of reactive oxygen species(ROS) when irradiated light of a specific wavelength. ROS can damage cancer cells.

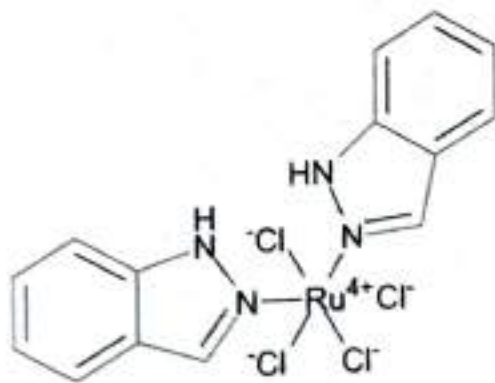
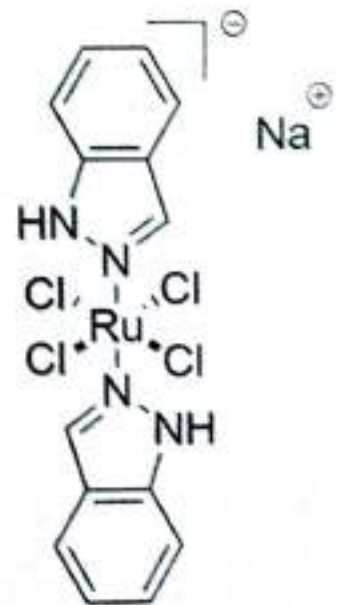


Fig.9:- Ruthenium based anticancer drug (BOLD-100)



❖ Detection of cancer by Cancer Biomarker and Fluorescent Dyes

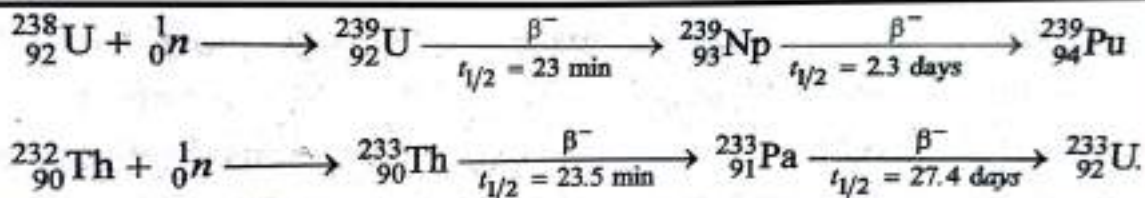
- Cancer biomarkers are molecules produced by cells or by the body in response to cancer.
- Detecting these biomarkers in early stages can improve diagnosis and treatment.
- Fluorescent dyes are chemical compounds that emit light when exposed to a specific wavelength of light.
- These dyes specifically bind to cancer biomarkers, and the attached fluorescent dyes illuminate the presence of cancer cells under specific lighting conditions.
- Use for early detection, diagnosis, and monitoring cancer treatment.
- Make surgery more effective
- PSA (prostate cancer), CA-125 (ovarian cancer)



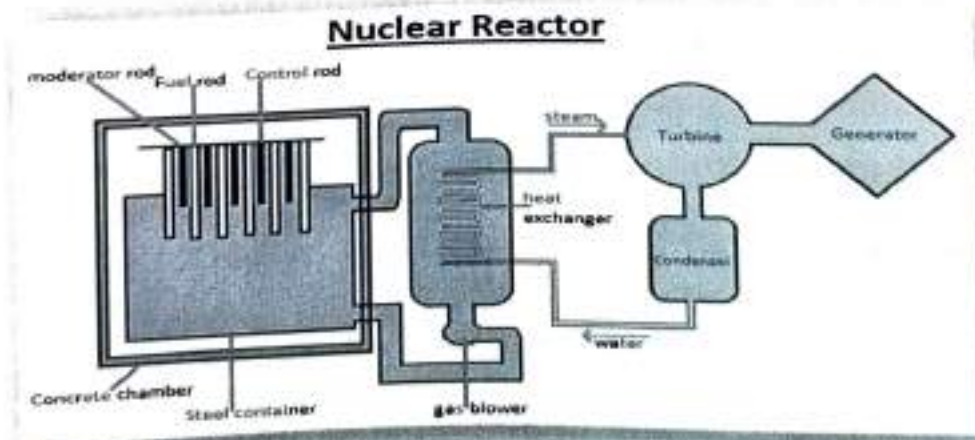
View of localized region of a cancer patient as seen with naked eye (left) or with the aid of tumor-targeted fluorescence dye (right)

❖ Nuclear Energy for Clean Power

- Nuclear energy is a low-carbon power source that can help mitigate climate change.
- Nuclear energy is generated through controlled nuclear reaction in Nuclear Reactor.
- In nuclear reactor usually fueled by U-235 or Pu-239.
- During fission, heavy atomic nuclei split into smaller nuclei, releasing large amount of energy in form of heat.



- This heat is used to produce steam, which drives turbines connected to generators to produce electricity.



- Advantage:**
1. Large amount of energy can produce
 2. Low carbon emission
 3. Reduce air pollution.