

Janata Shikshan Mandal's

Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad (Maharashtra)

2.3.1 Student centric methods, such as experiential learning, participative learning and problem solving methodologies are used for enhancing learning experiences

Sr. No .	Department	Name of the Activity Conducted	Date of the activity	Details of the Activity
1	Botany	Drawing Competition “All Botanicals”	7th March 2022	Conducted for all streams of science. About 22 students participated. Winners were awarded with exciting prizes.
		Photography Competition on World Fungus Day	2nd Oct 2021	16 entries were received. 8 students participated. Winners received certificates and prizes.
2	Zoology	Seminars for SYBSc Zoology Students	13 th October, 2021	Seminar Conducted for SYBSc Zoology Students. 10 Students Participated in the Seminar
3	Chemistry	How to prepare PPT?	8th -11th April 2022	TYBSc and M.Sc. students Presented ppt on selected topics in M. Sc. Classroom.
4	BMS	Webinar on GST	14 October 2021	Total 80 students participated
5	BMS	Online Orientation for FY	16 Sept. 2021	Total 86 students participated
6	BMS	Webinar on Writing Resume Report	16 th Oct 2021	115 students participated
7	Mathematics	Use of system of homogeneous linear equations in balancing chemical reaction.	10 th September 2021	9 students of S.Y.B.Sc.. Sem III completed their project
8	Mathematics	Use of system of homogeneous linear equations in electric circuit	10 th September 2021	9 students of S.Y.B..Sc.. Sem III completed their project

9	Physics	Simulation based practicals are conducted. Websites used are https://www.multisim.com/ https://vlab.amrita.edu/ https://www.tinkercad.com/	Academic year 2021-22	Practical of F. Y. B. Sc. , S. Y. B. Sc. and T. Y. B. Sc.
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PRINCIPAL
 Bsc., B.A., B.Com., B.B.A., B.B.L.,
 J. B. Sonawale College and
 Sonawale Group of Institutions
 College, Warananagar 401 001, Dist. Solapur

Janata Shikshan Mandal's

Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad.

ACTIVITY REPORT 2021-22

Sr. No.	Particulars	Details
1	Name of the activity	“All Botanicals” Drawing Competition
2	Name of the department	Botany
3	Date of the activity	7th March 2022
4	Coordinator Name	Dr. Preeti V. Phate
5	Venue of the activity	Botany department Lab No. 1 & 2
6	Number of participants	22
7	List of participants	Enclosed
8	Criteria No.	2
9	Link if any	-



Dr. P. V. Phate

Name and Signature of the Incharge



Principal
Smt. Indirabai G. Kulkarni Arts College,
J. B. Sawant Science College,
Sau. Janakibai D. Kunte Commerce College,
Alibag-402 001, Dist. Raigad

J.S.M. COLLEGE ALIBAG RAIGAD 402201

DEPARTMENT OF BOTANY
IS ORGANISING

DRAWING COMPETITION
ALL BOTANICALS

"Paint Your Imagination on Canvas"



MONDAY, 07 MARCH 2022
TIME: 11:00 AM - 1:30 PM
VENUE: DEPARTMENT OF BOTANY

Rules and Regulations

- The drawing should be related to the Botany subject.
- Only chart paper will be provided to each participant.
- Only individual entry will be allowed.
- Time limit will be one and half hour.
- Best three entries will be get exciting prizes.

For registration click on link: <https://forms.gle/4rJCDq1FnAThtuL6A>

Join WhatsApp group for further instructions
<https://chat.whatsapp.com/Join07yfo03AVJIC6QbweV>

Organizing committee

DR. A.K. PATIL, PRINCIPAL
DR. P.V. PHATE, HOD BOTANY
DR. M.A. PATIL
MRS. MANJUSHA PATIL
MISS. SAMRUDDHI PATIL

For queries Contact: Dr. P.V. Phate 7709366249 Miss. S.S. Patil 7448201996

J. S. M. College, Alibag

Department of Botany

Name of the Activity: Drawing Competition "ALL BOTANICALS" Paint your Imagination on Canvas

Venue: Botany Department Lab No. 1 & 2

Day & Date: Monday, 07/03/2022

Time: 11:00 am to 12:30 pm

Criterion No.:

ATTENDANCE LIST

Sr. No.	Name of the student	Class	Signature
B-1	Tej Sudip Raul.	S.Y. BSC	T.S. Raul.
B-2	Saurav Harishchandra Bhoir	S.Y. Bsc	G. Bhoir
B-3	Poorva Sandeep Gawade	T.Y. BSC	P. Gawade
B-4	Rohit Prasanna Joshi	T.Y. BSC	R. Joshi
B-5	Swaroop Krishna Bhure	T.Y. BSC	S. Bhure
B-6	Omkar Sudhir Mhabe	S.Y. BSC	O. Mhabe
B-7	Sumayya Salamuddin Sayyad	T.Y. BSC	S. Sayyad
B-8	Samiksha Kishor Kawale	T.Y. BSC	S. Kawale
B-9	Mansi Arun Beloskar	T.Y. BSC	M.A. Beloskar
B-10	Aysha Irfan Kulkarni	T.Y. BSC	A. Kulkarni
B-11	Sharina Rifayat Ghalte	T.Y. BSC	S. Ghalte
B-12	Saba Imtiyaz Khan	T.Y. BSC	S. Khan
B-13	Muskan Murad Tambe	F.Y. BSC	M. Tambe
B-14	Aliya Ansar Phatakare	F.Y. BSC	A. Phatakare
B-15	Purva Satyawar Koli	F.Y. BSC	P. Koli
B-16	Shreya Sandip Patil	F.Y. BSC	S. Patil
B-17	Sahana Suresh Shetty	F.Y. BSC	S. Shetty
B-18	JAY Pavan Patil	F.Y. BSC	J. Patil

J. S. M. College, Alibag-Raigad 402201

Department of Botany

Name of the Activity: Drawing Competition "ALL BOTANICALS" Paint your Imagination on Canvas

Venue: Botany Department Lab No. 1 & 2

Day & Date: Monday, 07/03/2022 Time: 11:00 am to 12:30 pm

No. of Participants :

FEEDBACK FORM

Sr. No.	Name of the Student	Overall Feedback			Sign.
		Good	Satisfactory	Excellent	
B1	Tej Sudip Raul.			✓	T.S. Raul
B2	Gaurav Harishchandra Bhoir			✓	Chandra
B3	Poorva Sandeep Gawade			✓	Poorva
B4	Rohit Prasanna Joshi			✓	Rohit
B5	Swaroop Krishna Bhure			✓	Swaroop
B6	Omkar Sudhir Mhalare			✓	Omkar
B7	Sumayya Salomuddin Sayyad.			✓	Sumayya
B8	Samiksha Kishor Kawale			✓	Kawale
B9	Manasi Arun Belaskar			✓	M.A. Belaskar
B10	Aysha Irfan Koelkar			✓	Koelkar
B11	Sharina Rifayat Ghalte			✓	Sharina
B12	Laba Imtiaz Khan			✓	Stake
B13	Muskan Murad Tambe			✓	Nishan
B14	Aliya Ansar Phatakare			✓	Phatakare
B15	Purva Satyawar Koli			✓	Purva
B16	Shreya Sandip Patil.			✓	Patil
B17	Sahana Suresh Shetty			✓	Shetty
B18	Jay Pavan Patil			✓	Patil
B19	Pranjal Shashikant Nandgaonkar			✓	Pranjal
B20	Isha Kasim Mujawar			✓	Isha

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Duck

HOD Botany

Principal



JANATA SHIKSHAN MANDAL'S
SMT. INDIRABAI G. KULKARNI ARTS, J.B. SAWANT SCIENCE AND
SAU. JANAKIBAI DHONDO KUNTE COMMERCE
COLLEGE, ALIBAG DIST. RAIGAD-402 201

Reaccredited by NAAC with 'B' Grade
Awarded Best College by University of Mumbai (2018-19)

DEPARTMENT OF BOTANY
DRAWING COMPETITION

All Botanicals

CERTIFICATE

*This certificate of appreciation is issued to Ms. Poorva Sandeep Gawade of class
T.Y.B.Sc. of J.S.M. College Alibag for her participation in Drawing competition
"All Botanicals" organized by Department of Botany on 7th March 2022.*

Dr. A. K. Patil
Principal
J.S.M College,
Alibag

Dr. P.V. Phate
HOD Botany
J.S.M College, Alibag

J.S.M. COLLEGE ALIBAG RAIGAD 402201

“ALL BOTANICALS”

Paint Your Imagination on Canvas

WINNERS

Isha Kasim Mujawar	1 st Rank
Omkar Sudhir Mhatre	2 nd Rank
Tej Sudip Raul	3 rd Rank
Purva Satyawar Koli	
Muskan Murad Tambe	4 th Rank

1st Rank

B-20



7/03/2022

Isha Kasim Mujawar F4BSc

2nd RANK

6-6



3rd Rank

B-6



07/03/2022

Saurav Harishchandra Bhar
54BSc

3rd Rank

B-15:



07/03/2022

Purva Satyawon Koli, FYBSc

Consolation Prize



B.12.

07/03/2022

Muskan Murod Tambe FYBSc



Alibag, Maharashtra, India

JVVC+C97, Limaye Wadi, Alibag, Maharashtra 402201, India

Lat 18.643685°

Long 72.870944°

07/03/22 11:12 AM



GPS Map Camera

Alibag, Maharashtra, India

JSM College Compound, Limaye Wadi, Alibag, Maharashtra

402201, India

Lat 18.643697°

Long 72.870712°

25/03/22 11:48 AM

Google



Alibag, Maharashtra, India

JSM College Compound, Limaye Wadi, Alibag, Maharashtra

402201, India

Lat 18.64375°

Long 72.87069°

25/03/22 11:29 AM



Janata Shikshan Mandal's

Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai Dhondo Kunte Commerce College and
J. S. M. College of Arts, Science & Commerce (Junior College)
Late Nanasaheb Kunte Educational Complex
Alibag, Dist. Raigad. Pin : 402 201. (Maharashtra)

Tel. Fax : 02141-222036
Tel. Principal : 02141-228361
E-mail : principal_jsm@rediffmail.com
jsmcalibag@gmail.com
web site : www.jsmalibag.edu.in
Index No. : JJ/17-07-008

Principal : Dr. Anil K. Patil (M.Sc., Ph.D.)

President : Adv. Gautam P. Patil

Permanently Affiliated to University of Mumbai. Included under section 2 (f), 12(B) of the U.G.C. Reaccredited by NAAC with 'B' Grade (CGPA: 2.03)
Mumbai University Best College Award 2018 - 2019.

Ref. No.

Date :

30/03/2022

REPORT

Department of Botany has organize Drawing competition "ALL BOTANICALS" Paint your imagination on Canvas, on 7th March 2022. The programme was arrange for all students of science stream programme.

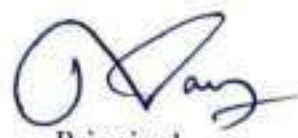
The theme of the competition was Botanical painting like paintings related to plant morphology, anatomy, illustration, mandala art etc. About 22 students participate in the competition. The winners were sorted on the basis of criteria like colour combination, drawing skills etc.

The results were announced and the winners were felicitated by Principal Dr. Anil Patil in the prize distribution ceremony held on 25th March 2022 at Department of Botany.

The result of the competition is as follows:

- | | |
|------------------------|------------------------|
| 1) Isha Kasim Mujawar | - 1 st Rank |
| 2) Omkar Sudhir Mhatre | - 2 nd Rank |
| 3) Tej Sudip Raul | - 3 rd Rank |
| 4) Purva Satyawar Koli | - 3 rd Rank |
| 5) Muskan Murad Tambe | - 4 th Rank |




Principal

Janata Shikshan Mandal's

Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad

ACTIVITY REPORT 2021-22

Sr. No.	Particulars	Details
1	Name of the activity	Seminars for S.Y.B.Sc. Zoology Students
2	Name of the department	Zoology
3	Date of the activity	13 th October, 2021
4	Coordinator Name	Prof. A. C. Ghatpande
5	Venue of the activity	Zoology Department
6	Number of participants	10
7	List of participants	Enclosed
8	Criteria No.	II
9	Link if any	-


Asst. Prof. Zoology Deptt.
J. S. M. College, Alibag
Dist. Raigad



PRINCIPAL
Smt. Indirabai G. Kulkarni Coll.,
J. B. Sawant Science and
Sau. Janakibai D. Kunte Commerce
College, Alibag Dist. Raigad
Principal

Janata Shikshan Mandal's
Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad

SEMINAR FOR S.Y.B.Sc. ZOOLOGY STUDENTS
Student list

Sr. No.	Roll No.	Name	Seminar Topic
1	HS 81	Samruddhi Patil	Apiculture- Introduction, Methods of bee keeping – Traditional and Modern.
2	HS 76	Vedanti Patil	Introduction to different species of honey bee used, selection of flora and bees used for apiculture.
3	HS 31	Tanvi Mali	Advantages and disadvantages of traditional and modern methods, Pest and bee enemies.
4	HS 47	Priyanka Chikte	Diseases of honey bees
5	HS 97	Sakshi Lawate	Bee keeping industry present status and economic importance
6	HS 79	Durva Mhatre	Vermiculture – Introduction, Methods
7	HS 67	Purva Koli	Vermiculture Methods of harvesting worms, Economic importance, marketing and entrepreneurship.
8	HS 23 HS 91	Rahul Naik, Shreyash Tiwari	Dairy science introduction, Dairy development and processing
9	HS 25	Sakshi Kadave	Milk – Composition, Types.
10	HS 28 HS 43	Lalitikumar Mali and Rohitkumar Prajapat	Milk products


Head of Zoology Dept.
J. S. M. College, Alibag
Dist. Raigad

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ACADEMIC YEAR – 2021-22

Activity Report

Name of Activity	How to prepare the ppt? M.Sc. And T.Y.B.Sc. (Chemistry)
Name of organizing Department	Department of Chemistry
Name of Co-ordinator	Dr. Prashant Chate Dr. Simantini Thakur
Name of Resource person (s)	--
Duration	08/04/2022, 09/04/2022 and 11/04/2022
Organized in collaboration with	--
Number of beneficiaries	62
Objectives	• To introduce mechanism for PowerPoint Presentation. • Types and researching PowerPoint Presentation. • Design and writing of PowerPoint Presentation.
Outcome(s)	• Students know the advantages & disadvantages of PPT. • They got idea about how to design and construct the PPT.


HOD BOTANY


PRINCIPAL
Smt. Indirabai G. Kulkarni Arts,
J. B. Sawant Science and
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College, Alibag-402 301, Dist. Raigad

Janata Shikshan Mandal's

Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad.

Academic Year – 2021-22 Department of Chemistry How to prepare the ppt? Attendance Sheet

Student Name	Prefix	Roll Number	Project Title
ABHISHEK BHASKAR TOLKAR	FS	33	Study of kokan cyclone and its impact on environment
AFREEN FAYYAZ PANCHULKAR	FS	235	Study of kokan cyclone
AJAY GAJANAND KUMAWAT	FS	60	Air pollution in Raigad
AKANKSHA ASHOK THAKUR	FS	21	Study of kokan cyclone and its impact on environment
AKANKSHA RAJESH BOBHATE.	FS	227	Study of kokan cyclone
AKSHAY ARUN PATIL	FS	61	Air pollution in Raigad
ANIKET ASHOK PATIL	FS	268	Study of tropical cyclone Nisarga
APEKSHA SANDEEP PATIL	FS	4	An analysis of Covid-19 impacts on education system in Alibag.
ARCHANA VINODKUMAR NAIR	FS	262	Study of tropical cyclone Nisarga
ARSH ASHRAF ANWARE	FS	203	Impact of water pollution in Alibag
BHUSHAN RAJENDRA KELASKAR	FS	206	Study of nisarg cyclone and its impact on raigad district
CHANDANI CHANDRAKANT CHOGALE	FS	51	A case study on: Study of kokan cyclone and its impact on environment
DHANASHREE SHYAM CHAULKAR	FS	39	Organic farming in alibag
DHANASHRI UDAY PATIL	FS	216	Water Pollution
DIVYA DILIP KAVALE	FS	18	Study of kokan cyclone and its impact on environment
GAYATRI KAILAS CHAULKAR	FS	228	Study of kokan cyclone
GLANCY KARNAS PEY	ES	241	Study of kokan cyclone and its impact on environment
HABIBUREHAMAN M. CHOUDHARI	FS	8	Environment status and solid waste management of raigad region
HUZEFA AKRAM TANDEL	FS	40	Organic farming in alibag
JAYDEEP SUDHAKAR GAIKAR	FS	11	Qualitative analysis in different brands of cold drinks available in the market
JUI AJAY WARE	FS	45	Organic farming in Alibag
JYOTI MANIK CHINNARATHOD	FS	56	Organic farming in kokan areas
KARAN ADARSHAN GHATKI	FS	38	Organic farming in alibag

KARAN VINAYAK NAIK	FS	222	Case study project: Organic farming in alibag
KASTURI NITIN SHIGWAN	FS	42	Organic farming in Alibag
KAUSHAL KISHOR KHANDALKAR	FS	207	Study of nisarg cyclone and its impact on raigad district
KRISHNA SULBHAJI AZADE	FS	68	Impact of Covid-19 pandemic on education system in India
MAITHILI MANGESH KOSBE	FS	240	Study of kokan cyclone and its impact on environment
MANASI NITIN POSAREKAR	FS	30	Water pollution in alibag
MANASVI MAHESH PATIL	FS	27	Water pollution in alibag
MANISH JANARDAN BHOIR	FS	223	Case study project: Organic farming in alibag
MANJIRI MOHAN TAMBADKAR	FS	239	Study of kokan cyclone and its impact on environment
MANSI AVINASH CHAULKAR	FS	2	An analysis of Covid-19 impacts on education system in alibag
MANSI MANOJ KATE	FS	66	Air pollution in Raigad
MANTHAN MILIND SURVE	FS	236	Study of kokan cyclone and its impact on environment
MAYUR HEMANT SHINDE	FS	261	A case study on: Organic farming
MOIHITA JAGDISH KOLI	FS	29	Water pollution in alibag
MUSKAN MUAAZZAM SAUDAGAR	FS	246	Amount of Baking soda and salt in bakries of Alibag
NEEHA KASIM MUJAWAR	FS	204	Study of nisarg cyclone and its impact on raigad district
NEHAL SANTOSH NIGADE	ES	101	Impact of water pollution in Alibag
NETRA SUDHAKAR RANE	FS	76	Impact of water pollution in Alibag
NIKHIL MANOJ RAUT	ES	248	Amount of Baking soda and salt in bakries of Alibag
NIKITA SUBHSH MANE	FS	254	Water Pollution in Kundalika River
NISHITA SANTOSH DANDEKAR	FS	49	A case study on: Study of kokan cyclone and its impact on environment
NITI PRAKASH JAGE	FS	37	Organic farming in alibag
OM MANGESH NAIK	FS	7	Environment status and solid waste management of raigad region
ONKAR DAMU BHALKAR	FS	73	Impact of Covid-19 pandemic on education system in India
POOJA HEMANT KATALE	FS	53	Organic farming in kokan areas
PRASAD RAJENDRA MHATRE	FS	265	Study of tropical cyclone Nisarga
PRATHAMESH PRAKASH THALE	FS	211	A case study on organic farming
PRATHAMESH PRAMOD RAUL	FS	14	Qualitative analysis in different brands of cold drinks available in the market
PRATHMESH KASHINATH KOLI	FS	44	Organic farming in Alibag
PRATIKSHA PRADEEP KATHE	FS	22	Study of kokan cyclone and its impact on environment
PRAYAG PRALHAD SURVE	FS	258	A case study on: Organic farming
RAHUL GULAB WANKHADE	FS	52	A case study on: Study of kokan cyclone and its impact on environment
RAJESH KUMAR KAMLESH	FS	220	Water Pollution

YADAV			
RHUCHITA MILIND TAVASLKAR	FS	208	A case study on organic farming
RUTUJA RAVINDRA KAVALE	FS	3	An analysis of Covid-19 impacts on education system in alibag
SAHIL RAMESH PATEL	FS	24	Water pollution in alibag
SAKSHI ASHOK KABALE	FS	210	A case study on organic farming
SAKSHI JANARDHAN PATIL	FS	256	Water Pollution in Kundalika River
SAKSHI SHIRISH KADAM	FS	54	Organic farming in kokan areas
SAMIDHA SANJAY MORE	FS	43	Organic farming in Alibag
SAMRUDDHI BABAN KADAM	FS	10	Environment status and solid waste management of raigad region
SAMRUDDHI RAM PATIL	FS	72	Impact of Covid-19 pandemic on education system in India
SAURAV RAJENDRA THAKUR	FS	213	Water Pollution
SAYALI ANAND GHARAT	FS	6	Environment status and solid waste management of raigad region
SHERON SIMON VIEGAS	ES	225	Case study project: Organic farming in alibag
SHRAVANI UDDHAV PAWAR	FS	35	Study of kokan cyclone and its impact on environment
SHREYA SANTOSH GHARAT	ES	207	Study of nisarg cyclone and its impact on raigad district
SHREYA VILAS GHARAT	FS	71	Impact of Covid-19 pandemic on education system in India
SHREYAS PRAKASH JOGLEKAR	ES	50	A case study on: Study of kokan cyclone and its impact on environment
SHRUTI ASHOK THALE	FS	266	Study of tropical cyclone Nisarga
SHRUTI PRADEEP BHATTIKAR	FS	248	Amount of Baking soda and salt in bakries of Alibag
SHUBHANIT SUBHASH THOMBARE	FS	58	Air pollution in Raigad
SHWETA PRAVIN PATIL.	FS	226	Case study project: Organic farming in alibag
SIDDHI GANESH RAUT	FS	249	Amount of Baking soda and salt in bakries of Alibag
SIDDHI RAJARAM PATIL	FS	1	An analysis of Covid-19 impacts on education system in alibag
SIDDHI SANJAY BHUVAD	FS	255	Water Pollution in Kundalika River
SIDDHI SUBAL MHATRE	FS	252	Impact of Covid-19 on education system of Alibag
SOHAM SATISH PATIL	DS	260	A case study on: Organic farming
SRUSHTI RAMESH PATEL	FS	23	Study of kokan cyclone and its impact on environment
SURABHI SURESH GHARAT	FS	75	Study of kokan cyclone and its impact on environment
SURAJ SANTOSH MHATRE	FS	55	Organic farming in kokan areas
SUSHMITA JITENDRA PATIL	FS	12	Qualitative analysis in different brands of cold drinks available in the market
SUVIDYA PARSHURAM PATIL	FS	16	Study of kokan cyclone and its impact on environment
SUYASH SUNIL RAUT	FS	257	Water Pollution in Kundalika River
SWAPNALI SHIVAJI DARADE	FS	259	A case study on: Organic farming

TAHOORA ZAHOOB BORKAR	FS	201	Impact of water pollution in Alibag
TANMAY VIJAY THAKUR	FS	260	Impact of Covid-19 on education system of Alibag
TANMAYI RAMBHAU PATIL	FS	234	Study of kokan cyclone
TEJAS DATTATREY NAIK	FS	209	A case study on organic farming
URVISH UMESH THAKUR	FS	221	Impact of Covid-19 on education system of Alibag
VEDANTI DINESH PATIL	ES	32	Study of kokan cyclone and its impact on environment
VINAY VASANT GHARAT	FS	15	Qualitative analysis in different brands of cold drinks available in the market
YASH PRASHANT KAWALE	FS	32	Study of kokan cyclone and its impact on environment



H. O. D. Chemistry Dept.




PRINCIPAL
 Bmt. Indira Bai G. Kulkarni Arts,
 J. B. Sawant Science and
 Late Jankibai Chandra Kunte Commerce
 College, Alibag-402 201, Dist. Raigad

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Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
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ACTIVITY REPORT 2021-22

Sr. No.	Particulars	Details
1	Name of the activity	Webinar on GST
2	Name of the department	BMS Department
3	Date of the activity	14 October 2021
4	Coordinator Name	Prof. Riddhi Guruji
5	Venue of the activity	Online (Google meet)
6	Number of participants	84
7	List of participants	Enclosed
8	Criteria No.	II
9	Link if any	http://meet.google.com/xhu-dneg-yfq



Prof. Shweta Mokul

In-Charge BMS



PRINCIPAL
Smt. Indirabai G. Kulkarni Arts,
J. B. Sawant Science and
Sau. Janakibai D. Kunte Commerce
College, Alibag-401 201, Dist. Raigad

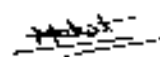
Janata Shikshan Mandal's
Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad

List of Students attended Webinar on GST

Sr.no	Roll. No.	Name of Student
1	GB-01	PATIL SAHIL VINOD
2	GB-05	TARE SIMRAN PRASHANT
3	GB-06	VARTAK HARSH KANCHAN
4	GB-07	KSHIRE CHIRAYU TUSHAR
5	GB-08	PALKAR ANUSHKA GANESH
6	GB-11	YERANDEKAR SHREEYA ASHISH
7	GB-12	AMBAVALE VIJAY DILIP
8	GB-13	GHARAT ROHIT KASHINATH
9	GB-16	KHATU ISHWARI SHRIRAM
10	GB-17	PATIL KAUSHAL SANTOSH
11	GB-19	SUTHAR VISHNU JEEVARAM
12	GB-21	NAIK DISHANT DEEPAK DAKSHATA
13	GB-22	PATIL ASHRAY ASHWINKUMAR
14	GB-27	AHIRE RAJRATNA DATTATRAYA
15	GB-31	SHRIVASTAV ADITI LALBABU
16	GB-35	PATEL NUPUR RAMESH
17	GB-37	PATIL TUSHAR SHANKAR
18	FB-46	KOLI SALONI RAJENDRA
19	FB-11	JATHAR KOMAL JAGANNATH
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21	FB-15	CHORAGE SIDDHESH JAGDISH
22	EB15	PATIL PRANAV PRAMOD
23	FB-17	BHAGAT PAYAL SANJAY
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33	FB-28	PATIL DEVIKA SANTOSH
34	FB-30	PATIL VIVEK VILAS
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36	FB-33	RAUT UNMESH PRAFULLA
37	EB-33	GHARAT PARAS KISHOR
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46	FB-45	RAUT SOHAM KIRAN
47	FB-46	JAIN AYUSH VIPUL
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49	EB-48	THAKUR SWARAJ SANDESH
50	FB-49	MOKAL RUTIK SUNIL
51	FB-50	JAIN HRITHIK VIJAY
52	FB-51	NAIK SHRADDHA MANGESH
53	FB-52	BURANDE SHIVALIKA ANAND
54	FB-53	SATVE GAURESH ANAND
55	FB-54	PATIL ROHAN MARUTI
56	FB-55	CHORDHEKAR JUEE SANTOSH
57	FB-56	AGRAWAL RAJ SANTOSH

58	FB-58	SHINDE SIDDHI JAYANT
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78	HB19	SINKAR MANTHAN SANTOSH
79	HB20	PATIL SARVESH BALKRUSHNA
80	HB21	MANE SAYALI PANDIT
81	HB22	MHATRE RASHMI PRAMOD
82	HB23	BHAGAT MANTHAN MILIND
83	HB24	JOSHI RAJ DILIP
84	HB25	RAUT SRUSHTI SHEKHAR

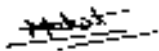


Prof. Shweta Mokul
(In-Charge, BMS)

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Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
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ACTIVITY REPORT 2021-22

Sr. No.	Particulars	Details
1	Name of the activity	Orientation of FY
2	Name of the department	BMS Department
3	Date of the activity	16 Sep 2021
4	Coordinator Name	Mr. Varun Patil & Mrs. Riddhi Guruji
5	Venue of the activity	Online
6	Number of participants	80
7	List of participants	Enclosed
8	Criteria No.	II
9	Link if any	https://meet.google.com/xfg-hqfz-uce



Prof. Shweta Mokul
(In-Charge)




Principal

J. S. M. College, Alibag

CORDIALLY INVITES YOU TO THE

Online Orientation 2021

SEPTEMBER 16, 2021

@09:30 A.M.

*For the First Year of "BMS"
2021-2022*

Janata Shikshan Mandal's

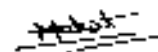
Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad

List of students attended Orientation Programme

Sr.no.	Roll. No.	Name of Student
1	GB-01	PATIL SAHIL VINOD
2	GB-05	TARE SIMRAN PRASHANT
3	GB-06	VARTAK HARSH KANCHAN
4	GB-07	KSHIRE CHIRAYU TUSHAR
5	GB-08	PALKAR ANUSHKA GANESH
6	GB-11	YERANDEKAR SHREEYA ASHISH
7	GB-12	AMBAVALE VIJAY DILIP
8	GB-13	GHARAT ROHIT KASHINATH
9	GB-16	KHATU ISHWARI SHRIRAM
10	GB-17	PATIL KAUSHAL SANTOSH
11	GB-19	SUTHAR VISHNU JEEVARAM
12	GB-21	NAIK DISHANT DEEPAK DAKSHATA
13	GB-22	PATIL ASHRAY ASHWINKUMAR
14	GB-27	AHIRE RAJRATNA DATTATRAYA
15	GB-31	SHRIVASTAV ADITI LALBABU
16	GB-35	PATEL NUPUR RAMESH
17	GB-37	PATIL TUSHAR SHANKAR
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27	FB-21	PATIL SHRUTIKA SANTOSH
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29	FB-24	PADWAL VAISHNAVI DINESH
30	FB-25	BHAVE GANDHALI RAJESH
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43	FB-41	KHOPKAR MAITHILI MILIND
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56	FB-55	CHORDHEKAR JUEE SANTOSH
57	FB-56	AGRAWAL RAJ SANTOSH
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79	HB20	PATIL SARVESH BALKRUSHNA
80	HB21	MANE SAYALI PANDIT

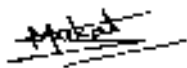


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ACTIVITY REPORT 2021-22

Sr. No.	Particulars	Details
1	Name of the activity	Webinar on Writing Resume
2	Name of the department	BMS Department
3	Date of the activity	16 October 2021
4	Coordinator Name	Prof. Riddhi Guruji
5	Venue of the activity	Online (Google meet)
6	Number of participants	115
7	List of participants	Enclosed
8	Criteria No.	II
9	Link if any	http://meet.google.com/xhu-dneg-yfq



Prof. Shweta Mokal
In-Charge BMS


PRINCIPAL
Smt. Indirabai G. Kulkarni Arts,
J. B. Sawant Science and
Sau. Janakibai D. Kunte Commerce
College, Alibag-422 001, Dist. Raigad

Principal

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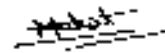
List of students attended Webinar on Resume Writing

Sr.no	Roll. No.	Name of Student
1	GB-01	PATIL SAHIL VINOD
2	GB-05	TARE SIMRAN PRASHANT
3	GB-06	VARTAK HARSH KANCHAN
4	GB-07	KSHIRE CHIRAYU TUSHAR
5	GB-08	PALKAR ANUSHKA GANESH
6	GB-09	HALDANKAR PRANIT PRAVIN
7	GB-10	HALDANKAR MANASI SANJAY
8	GB-11	YERANDEKAR SHREEYA ASHISH
9	GB-12	AMBAVALE VIJAY DILIP
10	GB-13	GHARAT ROHIT KASHINATH
11	GB-14	DESHMUKH MAYURESH MAHESH
12	GB-16	KHATU ISHWARI SHRIRAM
13	GB-17	PATIL KAUSHAL SANTOSH
14	GB-19	SUTHAR VISHNU JEEVARAM
15	GB-20	NAIK KRISHNA SURESH
16	GB-21	NAIK DISHANT DEEPAK DAKSHATA
17	GB-22	PATIL ASHRAY ASHWINKUMAR
18	GB-23	PATIL NEHA RITESH
19	GB-24	PHATAKARE AMAAN IOBAL
20	GB-25	KADAM RUCHA DILIP
21	GB-26	PATIL PRERANA PRAMOD
22	GB-27	AHIRE RAJRATNA DATTATRAYA
23	GB-28	GHODINDE PRATHAM SUHAS
24	GB-29	PADWAL AYUSH PRAVIN
25	GB-03	KAVALE ASHRAY DIPAK
26	GB-30	POTE SUJAY RAMESH
27	GB-31	SHRIVASTAV ADITI LALBABU

28	GB-32	MHATRE PRANAY JAYWANT
29	GB-33	KHARKAR AAYUSH DATTARAM
30	GB-34	KASAR VAISHNAVI KUNDAN KARUNA
31	GB-35	PATEL NUPUR RAMESH
32	GB-36	RAUL DEEP NILESH
33	GB-37	PATIL TUSHAR SHANKAR
34	GB-38	KHAN ANAS ASLAM
35	GB-39	KADAM TANVI PRAVIN
36	GB-4	DHAVAL HARSH DATTARAM
37	GB-40	NEVAREKAR VEDANT MAHESH
38	GB-41	THAKUR NIKHIL SUNIL
39	GB-42	JAIN PREET CHANDRAPRAKASH
40	GB-43	MALEKAR SHARVARI MARUTI
41	GB-44	JAIN RAHUL MUKESH
42	GB-45	PATIL RASIKA SHANKAR
43	GB-47	THAKUR APEKSHA KAILAS
44	GB-48	PAWAR SANYUKTA DIPAK PRATIBHA
45	GB-49	RAJBHAR PAWAN RAMKUMAR SUSASINI
46	GB-50	SATAMKAR SANCHIT HARISHCHANDRA RASHMI
47	GB-51	NAIK SHRUTI MAHENDRA MANSI
48	GB-52	PATIL ANIKET KIRAN SWATI
49	GB-53	MHATRE KAPIL HEMANT MANJULA
50	GN-18	KADAVE PRATIK RAMESH
51	FB-46	KOLI SALONI RAJENDRA
52	FB-1	GONDEKAR ANAS IMRAN
53	FB-2	LAMBATE ASMA NAJMUSAKIB
54	FB-3	PATIL OMKAR MAHESH
55	FB-4	MEHTA AKSHIT JITENDRA
56	FB-5	MADHAVI HEMANGI UDAY
57	FB-6	CHAYNAKHAWA YASH KISHOR
58	FB-7	DHONDSEKAR SHUBHAM SANTOSH
59	FB-9	PAWAR KALYANI PRASHANT
60	FB-10	JAIN ABHEE PRADEP
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114	HB13	SINKAR ADITYA PRADIP
115	HB14	GURAV SAKSHI MAHESH



Prof. Shweta Mokal
In-Charge BMS

Janata Shikshan Mandal's

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ACTIVITY REPORT 2021-22

Sr. No.	Particulars	Details
1	Name of the activity	Use of system of homogeneous linear equations in electric circuit
2	Name of the department	Mathematics
3	Date of the activity	10 th September, 2021
4	Coordinator Name	Prof. Mrs. G. A. Lonkar
5	Venue of the activity	Mathematics Department
6	Number of participants	09
7	List of participants	Enclosed
8	Criteria No.	II
9	Link if any	-



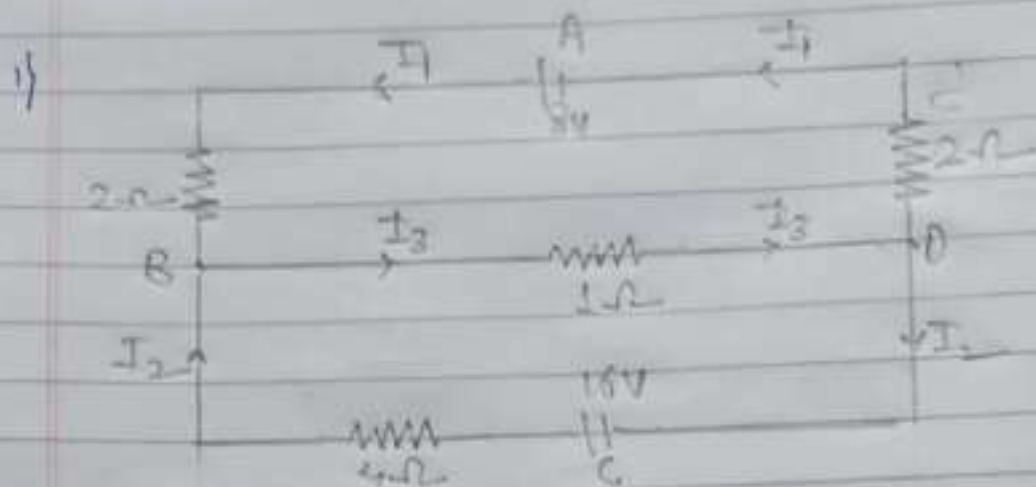
Prof. Mrs. G. A. Lonkar
Name and Signature of the Incharge



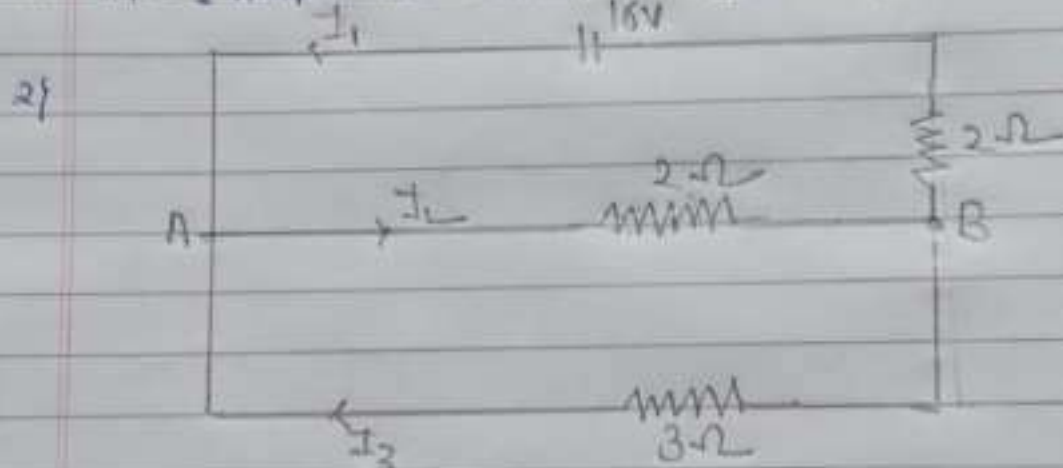
Principal

Electrical circuits

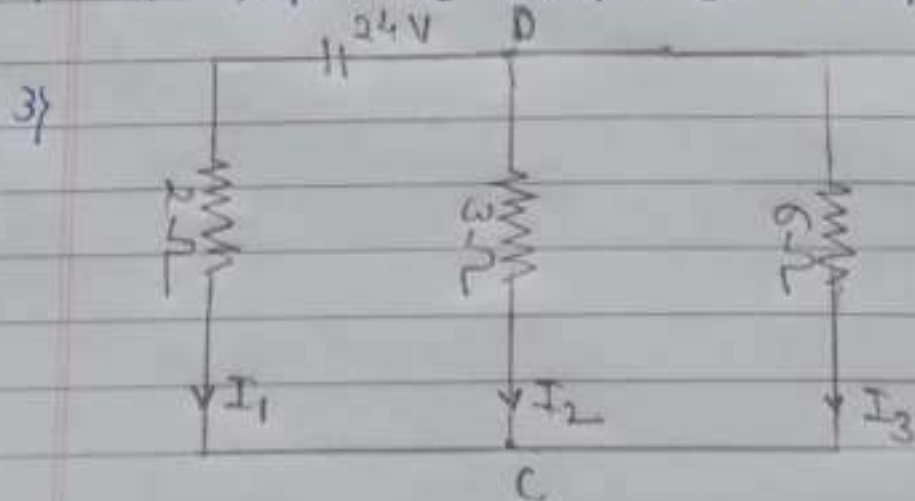
* Examples :



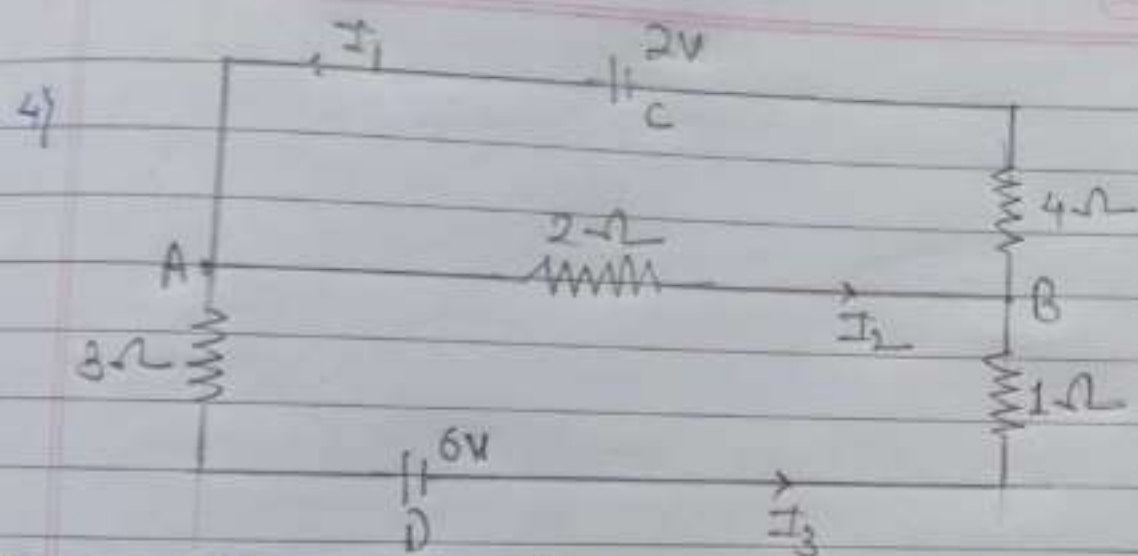
$$\Rightarrow I_1 = 1 \text{ Amp}, I_2 = 3 \text{ Amp}, I_3 = 4 \text{ Amp}$$



$$\Rightarrow I_1 = 5 \text{ Amp}, I_2 = 3 \text{ Amp}, I_3 = -2 \text{ Amp}$$



$$\Rightarrow I_1 = 6 \text{ Amp}, I_2 = -4 \text{ Amp}, I_3 = -2 \text{ Amp}$$



$I_1 = 0 \text{ Amp}, I_2 = 1 \text{ Amp}, I_3 = -1 \text{ Amp}.$



Ans - $I_1 = 1.4 \text{ amp}$, $I_2 = -0.39 \text{ amp}$, $I_3 = 0.3028 \text{ amp}$



Ans - $I_1 = 3.63 \text{ amp}$, $I_2 = 4.091 \text{ amp}$, $I_3 = 0.454 \text{ amp}$

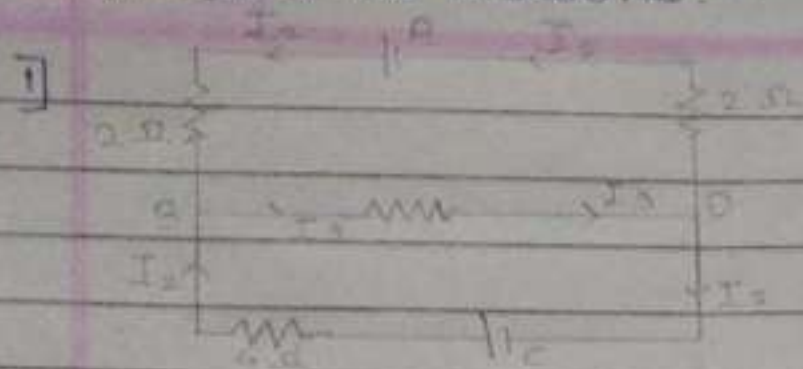


Ans - $I_1 = -4.56 \text{ amp}$, $I_2 = 1370 \text{ amp}$, $I_3 = -1.05 \text{ amp}$



Ans - $I_1 = 1.097 \text{ amp}$, $I_2 = 0.449 \text{ amp}$, $I_3 = 0.288 \text{ amp}$

Applications of System of Linear Equations to Electrical Networks.

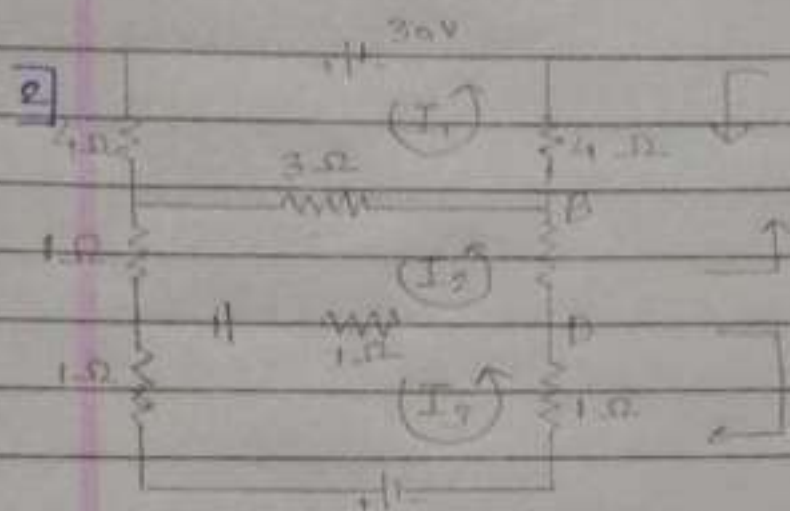


Ans

$$I_1 = 1 \text{ Amp}$$

$$I_2 = 3 \text{ Amp}$$

$$I_3 = 4 \text{ Amp}$$

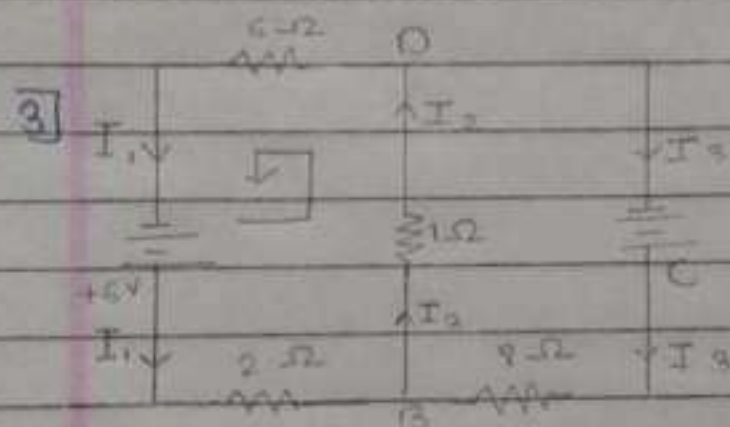


Ans

$$I_1 = 3$$

$$I_2 = 1$$

$$I_3 = -8$$

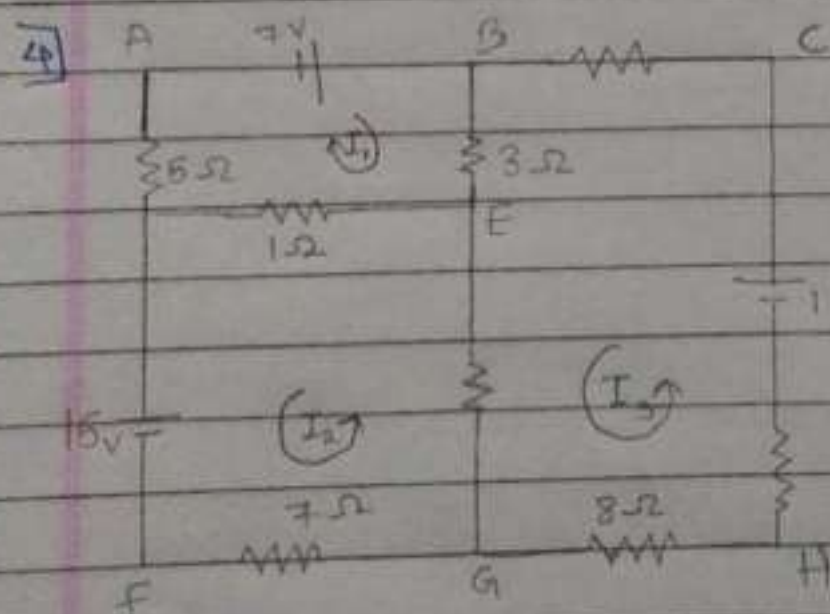


Ans

$$I_1 = 0.525 \text{ amp}$$

$$I_2 = 0.275 \text{ amp}$$

$$I_3 = 1.8 \text{ amp}$$



Ans

$$I_1 = 0.88 \text{ amps}$$

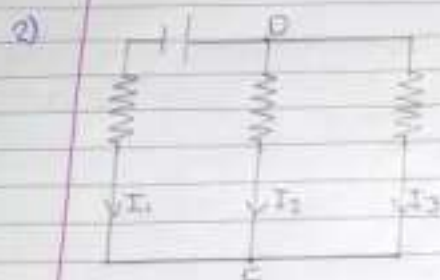
$$I_2 = -1.29 \text{ amps}$$

$$I_3 = 0.11 \text{ amps}$$

Electrical Circuits



Ans $I_1 = 0$, $I_2 = 1A$, $I_3 = -1A$



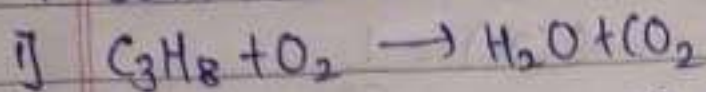
Ans $I_1 = 6A$, $I_2 = -4A$, $I_3 = -2A$



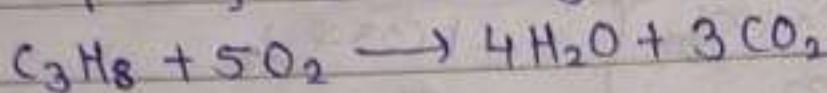
Ans $I_1 = 5A$, $I_2 = 3A$, $I_3 = -2A$

Balance the equations

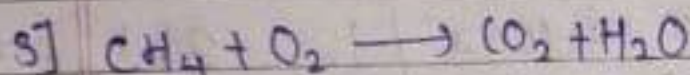
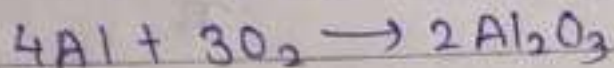
* Balance the chemical reaction using row echelon form



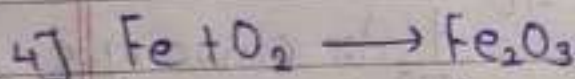
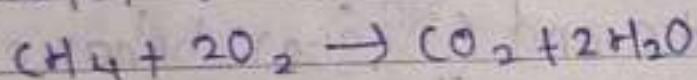
Ans:- $x_1 = 1, x_2 = 5, x_3 = 4, x_4 = 3$



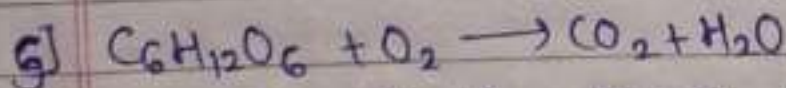
Ans:- $x_1 = 4, x_2 = 3, x_3 = 2$



Ans:- $x_1 = 1, x_2 = 2, x_3 = 1, x_4 = 2$

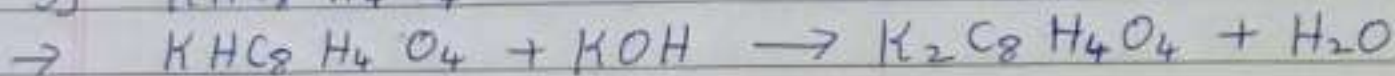
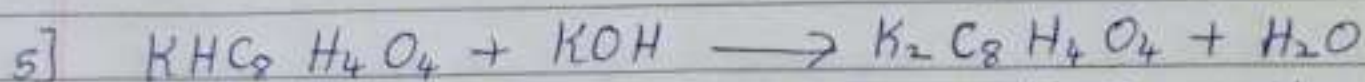
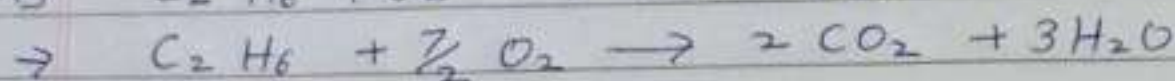
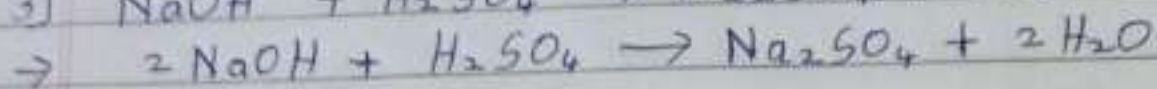
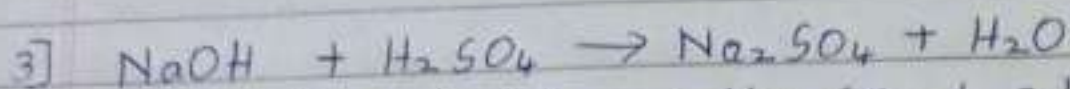
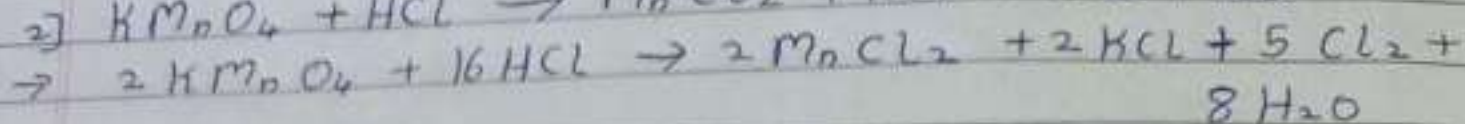
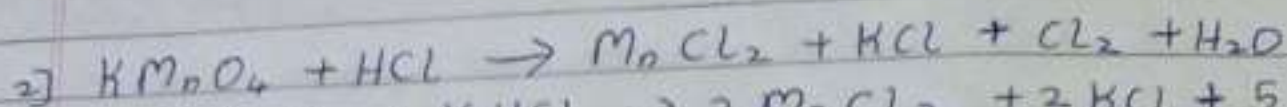
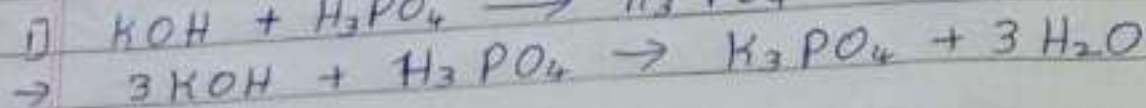
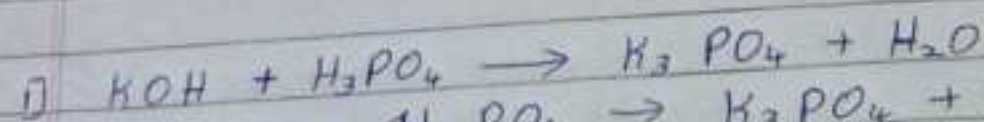


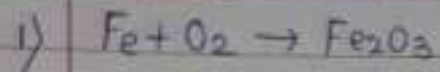
Ans:- $x_1 = 4, x_2 = 3, x_3 = 2$



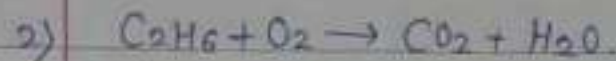
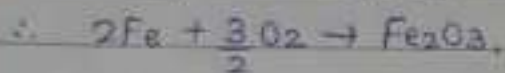
Ans:- $x_1 = 1, x_2 = 6, x_3 = 6, x_4 = 6$



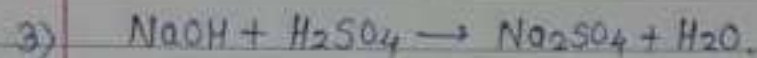
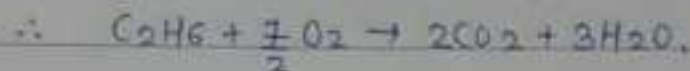




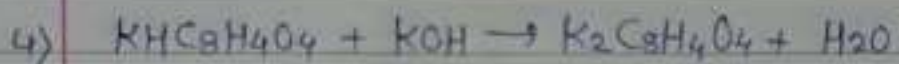
$$\rightarrow x_1 = 2, \quad x_2 = 3/2, \quad x_3 = 1.$$



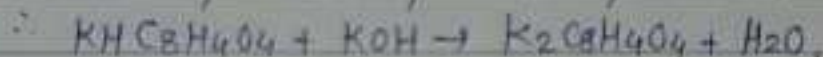
$$\rightarrow x_1 = 1, \quad x_2 = 7/2, \quad x_3 = 2, \quad x_4 = 3.$$

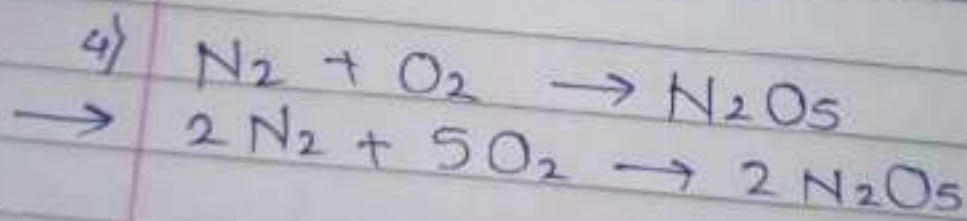
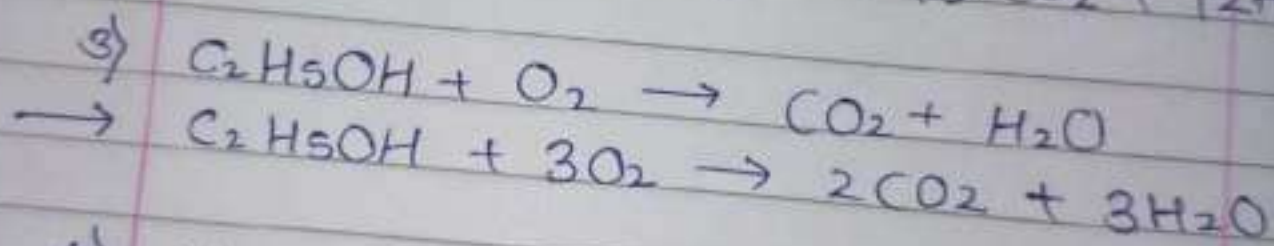
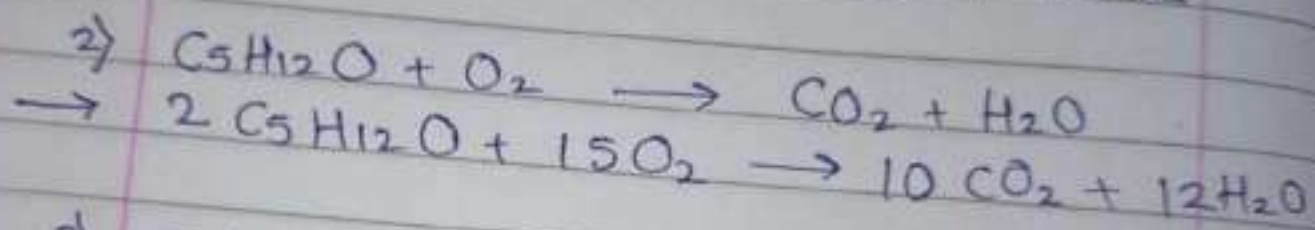
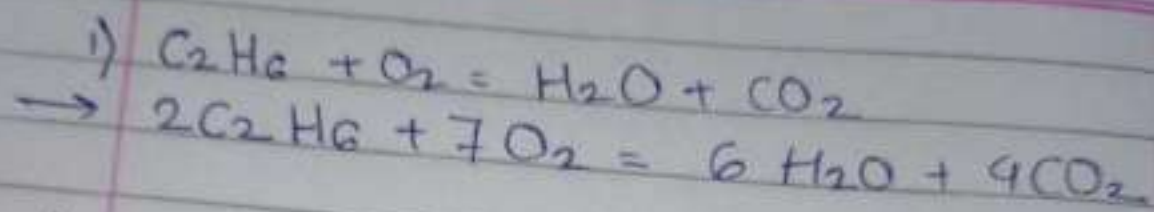


$$\rightarrow x_1 = 2, \quad x_2 = 1, \quad x_3 = 1, \quad x_4 = 2.$$

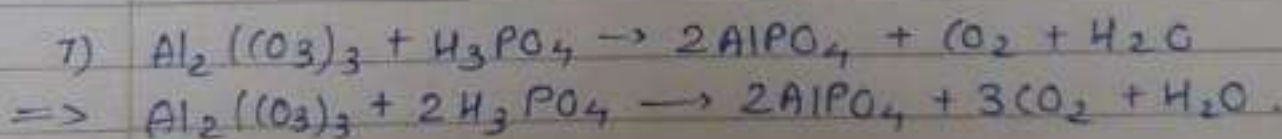
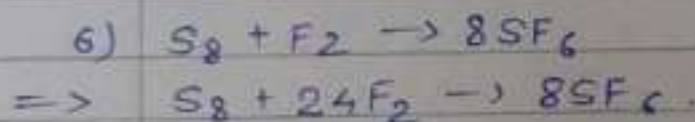
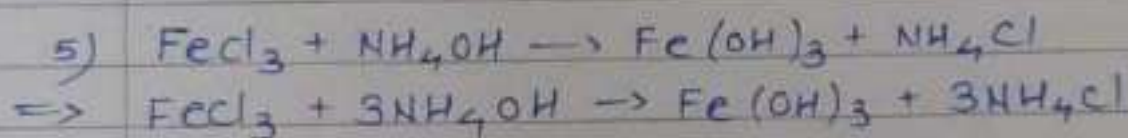
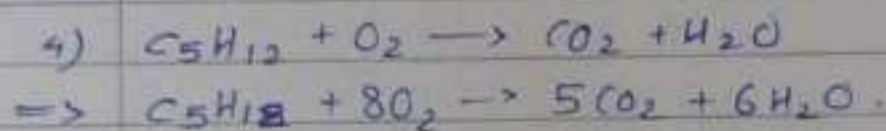
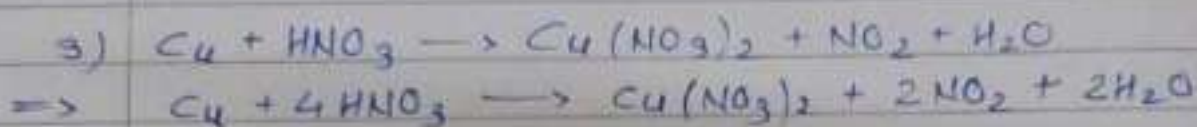
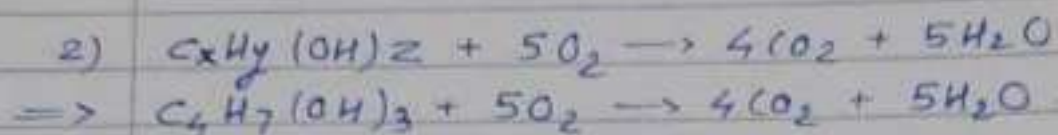
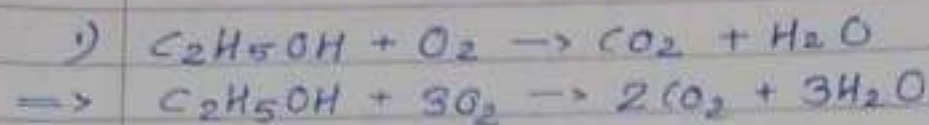


$$\rightarrow x_1 = 1, \quad x_2 = 1, \quad x_3 = 1, \quad x_4 = 1.$$





Balance Reactions :



Janata Shikshan Mandal's

Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and
Sau. Janakibai D. Kunte Commerce College, Alibag – Raigad.

ACTIVITY REPORT 2021-22

Sr. No.	Particulars	Details
1	Name of the activity	Use of system of homogeneous linear equations in balancing chemical reaction.
2	Name of the department	Mathematics
3	Date of the activity	10 th September, 2021
4	Coordinator Name	Prof. Mrs. G. A. Lonkar
5	Venue of the activity	Mathematics Department
6	Number of participants	09
7	List of participants	Enclosed
8	Criteria No.	II
9	Link if any	-



Prof. Mrs. G. A. Lonkar

Name and Signature of the Incharge



MATHS

PROJECT

Name :- Anya Arun Patil

Std :- SYBSc

Div :- A

Roll No :- GS - 04

Sub :- Maths

Project Name :- Application Of System Of Linear Equations

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SrNo	Topic	Sign
1]	Homogeneous system Non-Homogeneous system	
2]	Echelon form	
3]	Row echelon form	
4]	Application of row echelon form on chemical reaction	

HOMOGENEOUS SYSTEM

A homogeneous of linear equation is one in which all of the constant terms are zero. A homogeneous system always has at least one solution, namely the zero vector.

Non Homogeneous System

A non homogeneous system has an associated homogeneous system which you get by replacing the constant term in each equation with zero.

ECHELON FORM

In linear algebra, a matrix is in echelon form if it has the shape resulting from a Gaussian elimination. A matrix being in row echelon form means that Gaussian elimination has operated on the rows, and column echelon form means that Gaussian elimination has operated on the columns. In other words, a matrix is in column echelon form if its transpose is in row echelon form. Therefore, only row echelon forms are considered in the remainder of this article. The similar properties of column echelon form are easily deduced by transposing all the matrices. The term Gaussian elimination refers to the process until it has reached its upper triangular or row echelon form.

Row Echelon Form

A matrix is in reduced row echelon form (also called row canonical form) if it satisfies the following conditions:

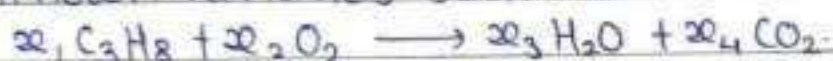
- 1] It is in row echelon form.
- 2] All rows consisting of only zeroes are at the bottom.
- 3] The leading coefficient (also called the pivot) of a non zero row is always strictly to the right of the leading coefficient of the row above it.
- 4] The leading entry in each non zero row is a 1 (called a leading 1).
- 5] Each column containing a leading 1 has zeros in all its other entries.

The reduced row echelon form of a matrix may be computed by Gauss-Jordan elimination. Unlike the row echelon form, the reduced row echelon form of a matrix is unique and does not depend on the algorithm used to compute. This is an example of a matrix in reduced row echelon form, which shows that the left part of the matrix is not always an identity matrix:

$$\begin{bmatrix} 1 & 0 & a_1 & 0 & b_1 \\ 0 & 1 & a_2 & 0 & b_2 \\ 0 & 0 & 0 & 1 & b_3 \end{bmatrix}$$

Application Of Row Echelon form On Chemical Reaction

1] $C_3H_8 + O_2 \rightarrow H_2O + CO_2$. Balance the equation.
sol:- In balancing the equation, let x_1, x_2 and x_3, x_4 be the unknown variables such that



we compare the number of carbon (C), Hydrogen (H) and oxygen (O) atoms of the reactants with the number of atom of the product we obtain the following set of equation

$$C: 3x_1 = x_4 \quad \therefore 3x_1 - x_4 = 0$$

$$H: 8x_1 = 2x_3 \quad \therefore 8x_1 - 2x_3 = 0$$

$$O: 2x_2 = x_3 + 2x_4 \quad \therefore 2x_2 - x_3 - 2x_4 = 0$$

The homogeneous system of equation become

$$\begin{bmatrix} 3 & 0 & 0 & -1 \\ 8 & 0 & -2 & 0 \\ 0 & 2 & -1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$3R_2 - 8R_1$$

$$\begin{bmatrix} 3 & 0 & 0 & -1 \\ 0 & 0 & -6 & 8 \\ 0 & 2 & -1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 - R_3$$

$$\begin{bmatrix} 3 & 0 & 0 & -1 \\ 0 & -2 & -5 & 10 \\ 0 & 2 & -1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_3 + R_2$$

$$\begin{bmatrix} 3 & 0 & 0 & -1 \\ 0 & -2 & -5 & 10 \\ 0 & 0 & -6 & 8 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\frac{1}{2} R_3$$

$$\begin{bmatrix} 3 & 0 & 0 & -1 \\ 0 & -2 & -5 & 10 \\ 0 & 0 & -3 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$3R_2 - 5R_3$$

$$\begin{bmatrix} 3 & 0 & 0 & -1 \\ 0 & -6 & 0 & 10 \\ 0 & 0 & -3 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\frac{1}{2} R_2$$

$$\begin{bmatrix} 3 & 0 & 0 & -1 \\ 0 & -3 & 0 & 5 \\ 0 & 0 & -3 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\frac{1}{3} R_1, -\frac{1}{3} R_2, -\frac{1}{3} R_3$$

$$\begin{bmatrix} 1 & 0 & 0 & -1/3 \\ 0 & 1 & 0 & -5/3 \\ 0 & 0 & 1 & -4/3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$r=3 \text{ and } n=4$$

$\therefore x_4$ is free variable.

The system has infinitely many solution.

$$x_1 - \frac{1}{3} x_4 = 0$$

$$\therefore x_1 = \frac{1}{3} x_4$$

$$x_2 - \frac{5}{3} x_4 = 0$$

$$\therefore x_2 = \frac{5}{3} x_4$$

$$x_3 - \frac{4}{3} x_4 = 0$$

$$\therefore x_3 = \frac{4}{3} x_4$$

put $x_4 = 3$

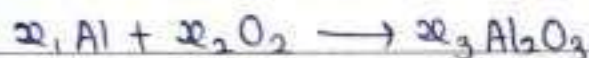
$\therefore x_1 = 1, x_2 = 5, x_3 = 4$

Therefore, the chemical equation can be balanced as,



2] $Al + O_2 \rightarrow Al_2O_3$. Balance the equation

solⁿ: In balancing the equation, let x_1, x_2 and x_3 be the unknown variables such that



We compare the number of Aluminium (Al) and oxygen (O) atoms of the reactants with the number of atom of the product we obtain the following set of equation

$$Al: x_1 = 2x_3 \quad \therefore x_1 - 2x_3 = 0$$

$$O: 2x_2 = 3x_3 \quad \therefore 2x_2 - 3x_3 = 0$$

The homogeneous system of equation become

$$\begin{bmatrix} 1 & 0 & -2 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\frac{1}{2} R_2$$

$$\begin{bmatrix} 1 & 0 & -2 \\ 0 & 1 & -3/2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$r=2 \text{ and } n=3$$

$\therefore x_3$ is free variable

The system has infinitely many solution.

$$x_1 - 2x_3 = 0 \quad \therefore x_1 = 2x_3$$

$$x_2 - \frac{3}{2}x_3 = 0 \quad \therefore x_2 = \frac{3}{2}x_3$$

put $x_3 = 2$

$$x_1 = 4, \quad x_2 = 3$$

therefore, the chemical equation can be balanced as,



3] $\text{CH}_4 + \text{O}_2 \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$. Balanced the equation.

solⁿ: In balancing the equation, let x_1, x_2, x_3 and x_4 be the unknown variables such that



we compare the number of Carbon (C), Hydrogen (H) and oxygen (O) atoms of the reactant with the number of atom of the product we obtain the following set of equation

$$\text{C: } x_1 = x_3 \quad \therefore x_1 - x_3 = 0$$

$$\text{H: } 4x_1 = 2x_4 \quad \therefore 4x_1 - 2x_4 = 0$$

$$\text{O: } 2x_2 = 2x_3 + x_4 \quad \therefore 2x_2 - 2x_3 - x_4 = 0$$

The homogeneous system of equation become.

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 4 & 0 & 0 & -2 \\ 0 & 2 & -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 - 4R_1, \quad -\frac{1}{2}R_3$$

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 0 & 4 & -2 \\ 0 & -1 & 1 & \frac{1}{2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 - R_3$$

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & 3 & -\frac{5}{2} \\ 0 & -1 & 1 & \frac{1}{2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_3 + R_2$$

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & 3 & -\frac{5}{2} \\ 0 & 0 & 4 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$R_2 - R_3$

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & -\frac{1}{2} \\ 0 & 0 & 4 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

 $R_3 \times \frac{1}{2}$

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & -1 & -\frac{1}{2} \\ 0 & 0 & 2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

 $-R_2 + R_3$

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & 1 & -\frac{3}{2} \\ 0 & 0 & 2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

 $R_3 \times \frac{1}{2}$

$$\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 1 & 1 & \frac{3}{2} \\ 0 & 0 & 1 & -\frac{1}{2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

 $R_1 + R_3, R_2 - R_3$

$$\begin{bmatrix} 1 & 0 & 0 & -\frac{1}{2} \\ 0 & 1 & 0 & -\frac{5}{2} \\ 0 & 0 & 1 & -\frac{1}{2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

 $r=3$ and $n=4$ $\therefore x_4$ is free variable

The system has infinitely many solution

$$x_1 - \frac{1}{2}x_4 = 0$$

$$\therefore x_1 = \frac{1}{2}x_4$$

$$x_2 - x_4 = 0$$

$$\therefore x_2 = x_4$$

$$x_3 - \frac{1}{2}x_4 = 0$$

$$\therefore x_3 = \frac{1}{2}x_4$$

put $x_4 = 2$

$$x_1 = 1, \quad x_2 = 2, \quad x_3 = 1$$

Therefore, the chemical equation can be balanced as,



4] $\text{Fe} + \text{O}_2 \longrightarrow \text{Fe}_2\text{O}_3$ Balanced the equation

solⁿ: In balancing the equation, let x_1, x_2 and x_3 be the unknown variables such that



We compare the number of iron (Fe) and oxygen (O) atoms of the reactants with the number of atom of the product we obtain the following set of equation

$$\text{Fe} : x_1 = 2x_3 \quad \therefore x_1 - 2x_3 = 0$$

$$\text{O} : 2x_2 = 3x_3 \quad \therefore 2x_2 - 3x_3 = 0$$

The homogeneous system of equation become

$$\begin{bmatrix} 1 & 0 & -2 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\frac{1}{2} R_2$$

$$\begin{bmatrix} \textcircled{1} & 0 & -2 \\ 0 & \textcircled{1} & -\frac{3}{2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$r=2 \text{ and } n=3$$

$\therefore x_3$ is free variable.

$\therefore$ The system has infinitely many solution

$$x_1 - 2x_3 = 0 \quad \therefore x_1 = 2x_3$$

$$2x_2 - \frac{3}{2}x_3 = 0 \quad \therefore x_2 = \frac{3}{2}x_3$$

$$\text{put } x_3 = 2$$

$$x_1 = 4, \quad x_2 = 3$$

Therefore, The chemical equation can be balanced as,



5] $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ Balanced the equation

sol: In balancing the equation, let x_1, x_2, x_3 and x_4 be the unknown variables such that



we compare the number of Carbon (C), Hydrogen (H) and oxygen (O) atoms of the reactants with the number of atom of the product we obtain the following set of equation

$$\text{C} : 6x_1 = x_3 \quad \therefore 6x_1 - x_3 = 0$$

$$\text{H} : 12x_1 = 2x_4 \quad \therefore 12x_1 - 2x_4 = 0$$

$$\text{O} : 6x_1 + 2x_2 = 2x_3 + x_4 \quad \therefore 6x_1 + 2x_2 - 2x_3 - x_4 = 0$$

The homogeneous system of equation become

$$\begin{bmatrix} 6 & 0 & -1 & 0 \\ 12 & 0 & 0 & -2 \\ 6 & 2 & -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 - 2R_1, \quad R_3 - R_1$$

$$\begin{bmatrix} 6 & 0 & -1 & 0 \\ 0 & 0 & 2 & -2 \\ 0 & 2 & -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 + R_3$$

$$\begin{bmatrix} 6 & 0 & -1 & 0 \\ 0 & 2 & 1 & -3 \\ 0 & 2 & -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_3 - R_2$$

$$\begin{bmatrix} 6 & 0 & -1 & 0 \\ 0 & 2 & 1 & -3 \\ 0 & 0 & -2 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$-\frac{1}{2}R_3$$

$$\begin{bmatrix} 6 & 0 & -1 & 0 \\ 0 & 2 & 1 & -3 \\ 0 & 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_1 + R_3$$

$$\begin{bmatrix} 6 & 0 & 0 & -1 \\ 0 & 2 & 1 & -3 \\ 0 & 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 - R_3$$

$$\begin{bmatrix} 6 & 0 & 0 & -1 \\ 0 & 2 & 0 & -2 \\ 0 & 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\therefore r=3 \text{ and } n=4$$

$\therefore x_4$ is free variable

$\therefore$ The system has infinitely many solution.

$$6x_1 - x_4 = 0$$

$$\therefore 6x_1 = x_4$$

$$2x_2 - 2x_4 = 0$$

$$\therefore 2x_2 = 2x_4$$

$$x_3 - x_4 = 0$$

$$\therefore x_3 = x_4$$

$$\text{put } x_4 = 6$$

$$x_1 = 1, \quad x_2 = 6, \quad x_3 = 6$$

Therefore, The chemical equation can be balanced as,



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Project Name :- Application of
System of linear Equation

College Name :- J.S.M. College,
Alibag.

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Linear Equations

A equation is said to be linear if the variable terms in each have degree 1.

Example,

$$2x + 3y = 5$$

System of Linear Equations

A general, system of m linear equations in n unknowns is given by,

$$a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = b_1$$

$$a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = b_2$$

$$a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n = b_m$$

where $x_1, x_2, \dots, x_n$ are unknowns

$b_i, a_{ij} \in \mathbb{R}$ and $i = 1, 2, \dots, m$

$j = 1, 2, \dots, n$

$\therefore$ In sigma notation the system can be written as,

$$\sum_{j=1}^n a_{ij}x_j = b_i, \quad 1 \leq i \leq m$$

Homogeneous System of Linear Equations

The system of m linear equations in n unknowns is said to be homogeneous if, all b_i 's $= 0$

ie., $\sum_{j=1}^n a_{ij}x_j = 0, 1 \leq i \leq m$

Matrix form of Homogeneous System is,
 $AX = 0$

ie.,

$$A = \begin{bmatrix} a_{11} & \dots & a_{1n} \\ a_{21} & \dots & a_{2n} \\ \vdots & & \vdots \\ a_{m1} & \dots & a_{mn} \end{bmatrix}, \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$\therefore$ Matrix form is,

$$\begin{bmatrix} a_{11} & \dots & a_{1n} \\ a_{21} & \dots & a_{2n} \\ \vdots & & \vdots \\ a_{m1} & \dots & a_{mn} \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Non-Homogeneous System of Linear equations

The system of m linear equations in n unknowns is said to be non-homogeneous if at least one $b_i \neq 0$.

i.e., $\sum_{j=1}^n a_{ij}x_j = b_i, \quad 1 \leq i \leq m$

Matrix form of non-homogeneous system is,

$$AX = B$$

i.e.,

$$A = \begin{bmatrix} a_{11} & \dots & a_{1n} \\ a_{21} & \dots & a_{2n} \\ \vdots & & \vdots \\ a_{m1} & \dots & a_{mn} \end{bmatrix}, \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, \quad B = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_m \end{bmatrix}$$

$\therefore$ Matrix form is,

$$\begin{bmatrix} a_{11} & \dots & a_{1n} \\ a_{21} & \dots & a_{2n} \\ \vdots & & \vdots \\ a_{m1} & \dots & a_{mn} \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_m \end{bmatrix}$$

A Solution of System of Linear Equations

Consider system of m linear equations in n unknowns.

i.e.,
$$\sum_{j=1}^n a_{ij}x_j = b_i, \quad 1 \leq i \leq m$$

All a_{ij} 's $\neq 0$, $b_i \neq 0$

If $x_1 = c_1, x_2 = c_2, \dots, x_n = c_n$ satisfy all m equations. Then, $(c_1, c_2, \dots, c_n)$ is solution of the system.

i.e.,

$$\sum_{j=1}^n a_{ij}c_j = b_i, \quad 1 \leq i \leq m$$

This solution is called common solution of the system.

Remarks :-

- ① System may have unique solution, no solution or infinitely many solutions.
- ② If the system has no solution then, it is said to be inconsistent.
- ③ If the system has unique or infinitely many solutions. Then, it is said to be consistent system.

- ④ The Homogeneous system always possesses the solution which is zero solution. This solution is also called as Trivial solution of the homogeneous system.
- ⑤ The solution of Homogeneous system other than zero solution is called Non-trivial solution. Thus, if $(c_1, c_2, \dots, c_n)$ is non-trivial solution of the homogeneous system. Then, at least one $c_i \neq 0$.
- ⑥ The system of Homogeneous linear equations is always consistent, since, it has always zero solution.

Examples.

1) Find the solution of the system.

$$2x + y = 0 \text{ and } x + y = 0.$$

$$\Rightarrow \text{consider, } 2x + y = 0 \text{ --- (1)}$$

$$x + y = 0 \text{ --- (2)}$$

$\therefore$ Subtracting (2) from (1),

$$\boxed{x = 0}$$

Put value of x in (1),

$$\therefore \boxed{y = 0}$$

$\therefore$ The given system has only trivial solution i.e. $(x, y) = (0, 0)$.

2) show that, the system of equations,
 $x - y + 2z = 0$, $3x + 2y + z = 0$, $4x + y + 5z = 0$ cannot
 have non-trivial solution.

$\Rightarrow$ We know that, system of three linear
 equations in three unknowns has non-trivial
 solution, iff $\Delta = 0$.
 consider,

$$\Delta = \begin{vmatrix} 1 & -1 & 2 \\ 3 & 2 & 1 \\ 4 & 1 & 5 \end{vmatrix}$$

$$= 1(10 - 1) + 1(15 - 4) + 2(3 - 8)$$

$$= 10 \neq 0$$

$$\therefore \Delta \neq 0$$

$\therefore$ system has ~~only~~ only trivial solution.

i.e. system does not have non-trivial solution.

Row Echleon form of System

- ① A zero row of matrix is the row whose all elements are zero.
- ② A non-zero row of a matrix whose the row in which at least one entry is non-zero.
- ③ Pivot element of the row is the non-zero entry of the row.

E.g.

$$\begin{bmatrix} \textcircled{1} & -2 & 3 & 0 \\ 0 & 0 & \textcircled{1} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Definition :

A matrix $m \times n$ is said to be Row Echleon form if it satisfies the following conditions :

- ① All non-zero rows of A should be above zero rows.
- ② The pivot element of each row should be to the right of the pivot element of the previous row.

Some Examples of Row Echleon form

convert the following matrices to Row Echleon form.

1) $A = \begin{bmatrix} 3 & 4 & 5 \\ 2 & 2 & 6 \\ 1 & 2 & 3 \end{bmatrix}$

$\Rightarrow$

$$A = \begin{bmatrix} 3 & 4 & 5 \\ 2 & 2 & 6 \\ 1 & 2 & 3 \end{bmatrix}$$

$$R_1 \leftrightarrow R_3$$

$$\therefore A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 2 & 6 \\ 3 & 4 & 5 \end{bmatrix}$$

$$R_2 \leftrightarrow R_3$$

$$\therefore A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & -2 & -4 \\ 0 & -2 & 0 \end{bmatrix}$$

$$R_3 - R_2$$

$$\therefore A = \begin{bmatrix} \textcircled{1} & 2 & 3 \\ 0 & \textcircled{1} & 2 \\ 0 & 0 & \textcircled{-2} \end{bmatrix}$$

$$R_2 - 2R_1, R_3 - 3R_1$$

$$\therefore A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & -2 & 0 \\ 0 & -2 & -4 \end{bmatrix}$$

$$-1/2 R_2, -1/2 R_3$$

$$\therefore A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & 1 & 0 \end{bmatrix}$$

This is Row Echleon form of matrix.

$$2) \quad A = \begin{bmatrix} 1 & 3 & 2 & 1 \\ 2 & 6 & 4 & 2 \end{bmatrix}$$

$\Rightarrow$

$$A = \begin{bmatrix} 1 & 3 & 2 & 1 \\ 2 & 6 & 4 & 2 \end{bmatrix}$$

$$R_2 - 2R_1$$

$$\therefore A = \begin{bmatrix} \textcircled{1} & 3 & 2 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

This is Row Echelon form of matrix.

$$3) \quad A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 2 & 1 & 2 & 1 \\ 1 & 2 & 1 & 2 \end{bmatrix}$$

$\Rightarrow$

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 2 & 1 & 2 & 1 \\ 1 & 2 & 1 & 2 \end{bmatrix}$$

$$R_2 - 2R_1, R_3 - R_1$$

$$\therefore A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 0 & -1 & 0 & -1 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

$$R_3 + R_2$$

$$\therefore A = \begin{bmatrix} \textcircled{1} & 1 & 1 & 1 \\ 0 & \textcircled{-1} & 0 & -1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

This is Row Echelon form of matrix.

Gaussian Elimination method To solve System of Equations

In this method,

- ① First write the system in the form

$$AX = B$$

- ② convert matrix A to its Row Echelon form.

- ③ If the reduce matrix has all non-zero rows or at least one zero row but the element corresponding to this row in the matrix B is also zero. Then, system is consistent i.e., system has a solution.

If corresponding zero row of A , the element in the matrix B is non-zero. Then, system has no solution.

- ④ Let r = no. of Pivot elements in the Row Echelon form of A .

and n = no. of unknowns.

i) If $r < n$. Then, there will be few columns not having Pivot elements.

Label the columns of A with corresponding variables. Mark the columns without Pivot element. Such variable is called free variable.

In this case, system has infinitely many solutions.

ii) If $r = n$. Then, system has unique solution which can be found from using the substitution.

Examples :

Solve the following system of equations

i) $2x + y - 4z = 6$, $3x - 2y + z = 3$ and $5x - y - 3z = 10$

→ The given system of equations is,

$$2x + y - 4z = 6,$$

$$3x - 2y + z = 3 \text{ and } 5x - y - 3z = 10$$

∴ The matrix form is,

$$AX = B$$

$$\begin{bmatrix} 2 & 1 & -4 \\ 3 & -2 & 1 \\ 5 & -1 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 3 \\ 10 \end{bmatrix}$$

$$R_1 \leftrightarrow R_2$$

$$\begin{bmatrix} 3 & -2 & 1 \\ 2 & 1 & -4 \\ 5 & -1 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 3 \\ 6 \\ 10 \end{bmatrix}$$

$$R_1 - R_2$$

$$\begin{bmatrix} 1 & -3 & 5 \\ 2 & 1 & -4 \\ 5 & -1 & -3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 \\ 6 \\ 10 \end{bmatrix}$$

$$R_2 - 2R_1, R_3 - 5R_1$$

$$\begin{bmatrix} 1 & -3 & 5 \\ 0 & 7 & -14 \\ 0 & 14 & -28 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 \\ 12 \\ 25 \end{bmatrix}$$

$$R_3 - 2R_2$$

$$\begin{bmatrix} \textcircled{1} & -3 & 5 \\ 0 & \textcircled{7} & -14 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 \\ 12 \\ \textcircled{1} \end{bmatrix}$$

This is Row Echelon form of matrix.

Here, $r=2$, $n=3$, $r < n$

A is in Row Echelon form and last row

of A is zero. But last row B is non-zero.
 $\therefore$ The given system of equations has no solution.

2) $x+3y-2z=1$, $2x+6y-5z=6$
 $\Rightarrow$ The given system of equations is,
 $x+3y-2z=1$ and $2x+6y-5z=6$
 Then, the matrix form of the system is,

$$AX=B$$

$$\therefore \begin{bmatrix} 1 & 3 & -2 \\ 2 & 6 & -5 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 6 \end{bmatrix}$$

$$R_2 - 2R_1$$

$$\begin{bmatrix} 1 & 3 & -2 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 4 \end{bmatrix}$$

This is Row Echelon form of matrix.

Here, $r=2$, $n=3$, $r < n$

$\therefore$ The system has infinitely many solutions.

Also,

$$\begin{bmatrix} x & y & z \\ 1 & 3 & -2 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 4 \\ 4 \end{bmatrix}$$

Given that, the column of y has no pivot elements. Therefore, y is a free variable.

$\therefore$ we get, $\boxed{y=t}$, $t \in \mathbb{R}$

Then, by back substitution method,

$$x+3y-2z=1 \quad \text{and} \quad -z=4 \quad \therefore \boxed{z=-4}$$

$$\therefore x+3t+8=1$$

$$\therefore x=-7-3t \quad \therefore \boxed{x=7+3t}, \quad t \in \mathbb{R}$$

$\therefore$ The infinite solutions of the system are,

$$(x, y, z) = (7+3t, t, -4), \quad t \in \mathbb{R}.$$

3) $3x + y = 5, x - y = 3$

$\Rightarrow$ The given system of equations is,
 $3x + y = 5$ and $x - y = 3$

$\therefore$ The matrix form of system is,

$$AX = B$$

$$\begin{bmatrix} 3 & 1 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 3 \end{bmatrix}$$

$$R_1 \leftrightarrow R_2$$

$$\begin{bmatrix} 1 & -1 \\ 3 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 \\ 5 \end{bmatrix}$$

$$R_2 - 3R_1$$

$$\begin{bmatrix} 1 & -1 \\ 0 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 \\ -4 \end{bmatrix}$$

This is Row Echelon form of matrix.

Here, $r = 2, n = 2 \therefore r = n$

$\therefore$ The system has unique solution.

Then, by using back substitution method,
 $x - y = 3$ and $4y = -4$

$$\therefore \boxed{y = -1}$$

$$\therefore x + 1 = 3 \therefore \boxed{x = 2}$$

$\therefore$ The unique solution of the system of given equations is,

$$(x, y) = (2, -1).$$

Applications of System of linear Equations in Electrical Networks

Electrical networks are a specialized type of providing information about power sources, such as batteries and devices powered by these sources, such as light bulbs or motors. A power source forces a current to flow through the network where it encounters various resistors, each which requires a certain amount of force to be applied in order for the current to flow through.

Systems of linear equations are used to determine the currents through various branches of electrical networks.

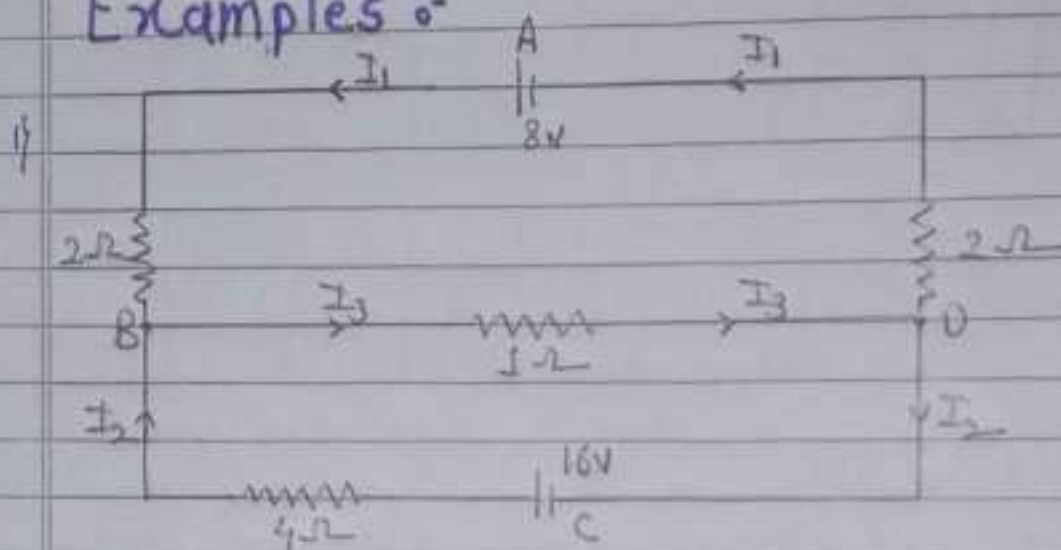
Ohm's law :-

The voltage drop across a resistor is given by, $V = IR$

Kirchoff's law :-

- Junction - All the current flowing into a junction must flow out of it.
- Path - The sum of the IR terms in any direction around a closed path is equal to the total voltage in the path in that direction.

Examples:-



→ Let the currents in the various branches of the circuit be I_1 , I_2 and I_3 . Applying Kirchhoff's law, there are two junctions in the circuit namely the points B and D. There are two closed paths ABDA and CBDC. Applying Kirchhoff's law to the junctions and paths, we get,

Junctions - B: $I_1 + I_2 = I_3$
and D: $I_3 = I_1 + I_2$

These two equations result in a single linear equation.

$$\therefore I_1 + I_2 - I_3 = 0 \quad \text{--- (1)}$$

Paths - ABDA: $2I_1 + 1I_3 + 2I_1 = 8$

$$\therefore 4I_1 + I_3 = 8 \quad \text{--- (2)}$$

and CBDC: $4I_2 + 1I_3 = 16 \quad \text{--- (3)}$

The network can be represented by the augmented form of matrix,

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 0 \\ 4 & 0 & 1 & 8 \\ 0 & 4 & 1 & 16 \end{array} \right]$$

$$R_2 - 4R_1$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 0 \\ 0 & -4 & 5 & 8 \\ 0 & 4 & 1 & 16 \end{array} \right]$$

$$R_3 + R_2$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 0 \\ 0 & -4 & 5 & 8 \\ 0 & 0 & 6 & 24 \end{array} \right]$$

$$2. \left[\begin{array}{ccc|c} \textcircled{1} & 1 & -1 & 0 \\ 0 & \textcircled{-4} & 5 & 8 \\ 0 & 0 & \textcircled{6} & 24 \end{array} \right]$$

This is Row Echelon Form of matrix.

$$\text{Here, } r=3, n=3 \therefore r=n$$

$\therefore$ The system has unique solution.

Then, by using back substitution method,

$$I_1 + I_2 - I_3 = 0 \quad , \quad -4I_2 + 5I_3 = 8$$

$$\text{and } 6I_3 = 24 \therefore \boxed{I_3 = 4}$$

$$-4I_2 + 20 = 8 \quad \therefore -4I_2 = -12$$

$$\therefore \boxed{I_2 = 3}$$

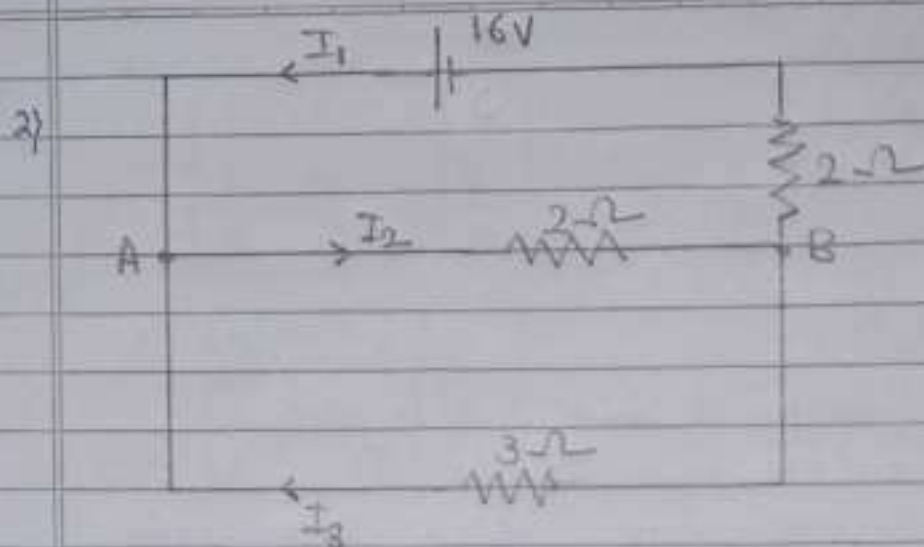
And

$$I_1 + 3 - 4 = 0 \quad \therefore I_1 - 1 = 0$$

$$\therefore \boxed{I_1 = 1}$$

$\therefore$ Values of currents I_1, I_2 and I_3 are,

$$I_1 = 1 \text{ Amp}, I_2 = 3 \text{ Amp and } I_3 = 4 \text{ Amp.}$$



⇒ Let the currents in the various branches of the circuit be I_1 , I_2 and I_3 . Applying Kirchhoff's law, there are two junctions in the circuit namely the points A and B. And there are two loops: top loop and bottom loop.

Then, by Applying Kirchhoff's law to the junctions and loops we get,

Junctions - A: $I_1 + I_3 = I_2$

And B: $I_2 = I_1 + I_3$

These two equations result in a single linear equation.

$$I_1 - I_2 + I_3 = 0 \quad \text{--- (1)}$$

Loops - Top loop: $2I_1 + 2I_2 = 16 \quad \text{--- (2)}$

And Bottom loop: $2I_2 + 3I_3 = 0 \quad \text{--- (3)}$

The network can be represented by the augmented form of matrix.

$$\left[\begin{array}{ccc|c} 1 & -1 & 1 & 0 \\ 2 & 2 & 0 & 16 \\ 0 & 2 & 3 & 0 \end{array} \right]$$

$$R_2 - 2R_1$$

$$\begin{bmatrix} 1 & -1 & 1 & | & 0 \\ 0 & 4 & -2 & | & 16 \\ 0 & 2 & 3 & | & 0 \end{bmatrix}$$

$$2R_3 - R_2$$

$$\begin{bmatrix} 1 & -1 & 1 & | & 0 \\ 0 & 4 & -2 & | & 16 \\ 0 & 0 & 8 & | & -16 \end{bmatrix}$$

$$\therefore \begin{bmatrix} \textcircled{1} & -1 & 1 & | & 0 \\ 0 & \textcircled{4} & -2 & | & 16 \\ 0 & 0 & \textcircled{8} & | & -16 \end{bmatrix}$$

This is Row Echelon form of matrix.

$$\text{Here, } r=3, n=3 \quad r=n$$

$\therefore$ The system has unique solution.

Then, by using back substitution method,

$$I_1 - I_2 + I_3 = 0, \quad 4I_2 - 2I_3 = 16$$

$$\text{And } 8I_3 = -16$$

$$\therefore \boxed{I_3 = -2}$$

$$\therefore 4I_2 - 2(-2) = 16$$

$$\therefore 4I_2 = 16 - 4$$

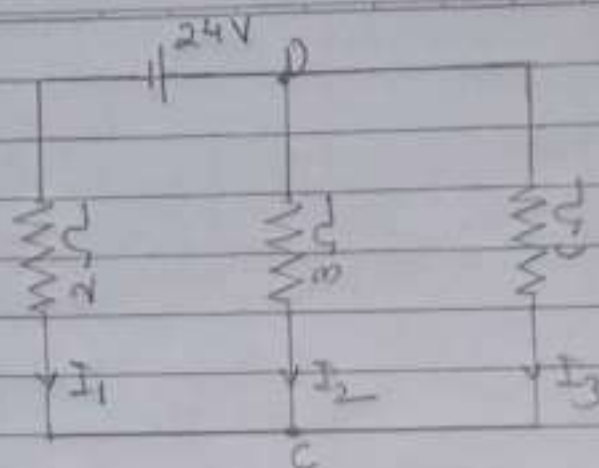
$$\therefore \boxed{I_2 = 3}$$

$$I_1 - 3 - 2 = 0$$

$$\therefore I_1 - 5 = 0 \quad \therefore \boxed{I_1 = 5}$$

$\therefore$ Values of currents I_1 , I_2 and I_3 are,
 $I_1 = 5A$, $I_2 = 3A$ and $I_3 = -2A$.

3)



$\Rightarrow$ Let the currents in the various branches of the circuit be I_1 , I_2 and I_3 . Applying Kirchhoff's law, there are two junctions in the circuit namely the points C and D. And there are two loops.

Then, by Applying Kirchhoff's law to the junctions and loops we get,

Junctions - C: $I_1 + I_2 + I_3 = 0$

And D: $-I_1 - I_2 - I_3 = 0$

These two equations Result in a single linear equation.

$$I_1 + I_2 + I_3 = 0 \quad \text{--- (1)}$$

Loops - loop I: $2I_1 - 3I_2 = 24 \quad \text{--- (2)}$

And loop II: $3I_2 - 6I_3 = 0 \quad \text{--- (3)}$

The network can be represented by the augmented form of matrix.

$$\left[\begin{array}{ccc|c} 1 & 1 & 1 & 0 \\ 2 & -3 & 0 & 24 \\ 0 & 3 & -6 & 0 \end{array} \right]$$

$$R_2 - 2R_1$$

$$\left[\begin{array}{ccc|c} 1 & 1 & 1 & 0 \\ 0 & -5 & -2 & 24 \\ 0 & 3 & -6 & 0 \end{array} \right]$$

$$\frac{1}{3}R_3$$

$$\left[\begin{array}{ccc|c} 1 & 1 & 1 & 0 \\ 0 & -5 & -2 & 24 \\ 0 & 1 & -2 & 0 \end{array} \right]$$

$$5R_3 + R_2$$

$$\left[\begin{array}{ccc|c} 1 & 1 & 1 & 0 \\ 0 & -5 & -2 & 24 \\ 0 & 0 & -12 & 24 \end{array} \right]$$

$$\therefore \left[\begin{array}{ccc|c} \textcircled{1} & 1 & 1 & 0 \\ 0 & \textcircled{-5} & -2 & 24 \\ 0 & 0 & \textcircled{-12} & 24 \end{array} \right]$$

This is Row Echelon form of matrix

$$\text{Here, } r=3, n=3 \quad r=n$$

$\therefore$ The system has unique solution.

Then, by using back substitution method,

$$I_1 + I_2 + I_3 = 0, \quad -5I_2 - 2I_3 = 24$$

$$\text{And } -12I_3 = 24$$

$$\therefore \boxed{I_3 = -2}$$

$$-5I_2 + 4 = 24$$

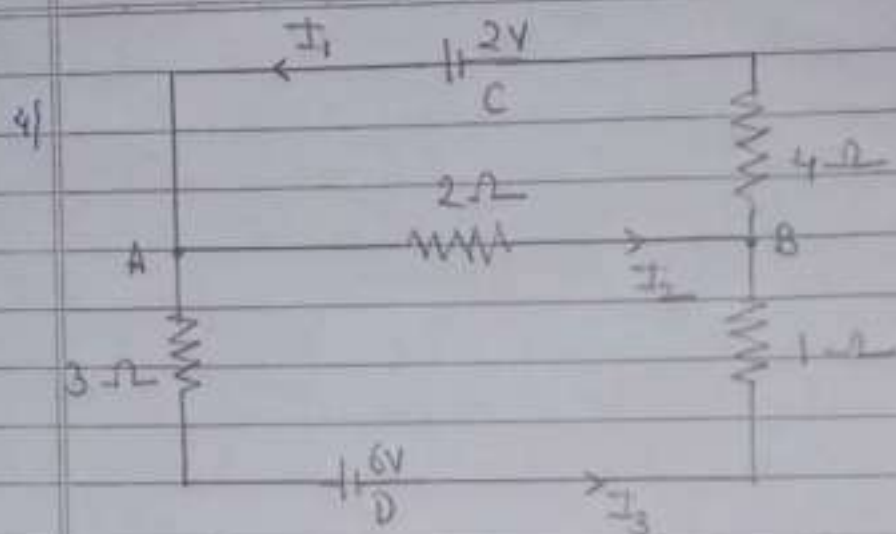
$$\therefore -5I_2 = 20$$

$$\therefore \boxed{I_2 = -4}$$

$$I_1 - 4 - 2 = 0$$

$$\therefore I_1 - 6 = 0 \quad \therefore \boxed{I_1 = 6}$$

$\therefore$ Values of currents I_1 , I_2 and I_3 are,
 $I_1 = 6A$, $I_2 = -4A$, $I_3 = -2A$.



⇒ Let the currents in the various branches of the circuit be I_1 , I_2 and I_3 . Applying Kirchhoff's law, there are two junctions in the circuit namely the points A and B. There are two closed paths CABC and DABD. Applying Kirchhoff's law to the junctions and paths we get,

Junctions - A: $I_1 = I_2 + I_3$

and B: $I_2 + I_3 = I_1$

These two equations result in a single linear equation.

$$I_1 - I_2 - I_3 = 0 \quad \text{--- (1)}$$

Paths - CABC: $4I_1 + 2I_2 = 2 \quad \text{--- (2)}$

and DABD: $-3I_1 + 2I_2 - 1I_3 = 6$

$$-2I_2 - 4I_3 = 0 \quad \text{--- (3)}$$

The network can be represented by the augmented form of matrix.

$$\left[\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ 4 & 2 & 0 & 2 \\ 0 & 2 & -4 & 6 \end{array} \right]$$

$$R_3 - 4R_1$$

$$\begin{bmatrix} 1 & -1 & -1 & 0 \\ 0 & 6 & 4 & 2 \\ 0 & 2 & -4 & 6 \end{bmatrix}$$

$$3R_3 - R_2$$

$$\begin{bmatrix} 1 & -1 & -1 & 0 \\ 0 & 6 & 4 & 2 \\ 0 & 0 & -16 & 16 \end{bmatrix}$$

$$\therefore \begin{bmatrix} \textcircled{1} & -1 & -1 & 0 \\ 0 & \textcircled{6} & 4 & 2 \\ 0 & 0 & \textcircled{-16} & 16 \end{bmatrix}$$

This is Row Echelon Form of matrix.

$$\text{Here, } r=3, n=3, r=n$$

$\therefore$ The system has unique solution.

Then, by using back substitution method,

$$I_1 - I_2 - I_3 = 0, \quad 6I_2 + 4I_3 = 2$$

$$\text{and } -16I_3 = 16$$

$$\therefore \boxed{I_3 = -1}$$

$$6I_2 - 4 = 2$$

$$\therefore 6I_2 = 6$$

$$\therefore \boxed{I_2 = 1}$$

And

$$I_1 - 1 + 1 = 0 \quad \therefore \boxed{I_1 = 0}$$

$\therefore$ Values of currents I_1, I_2 and I_3 are,
 $I_1 = 0 \text{ A}, I_2 = 1 \text{ A}$ and $I_3 = -1 \text{ A}.$

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Subject :- Maths

Topic :- Balancing a Chemical
Reaction Using Algebraic
Approach

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INTRODUCTION

Balancing of chemical equation is one of the initial subjects taught in most preliminary chemistry courses. A chemical reaction equation clarifies the reaction. According Ristexki, chemical equation is 'a symbolic representation of chemical reaction and represents expressions of compounds, elements or ions', where the reactants are given on L.H.S and products on R.H.S. In chemistry, balancing a chemical equation is one of the basic requirements. Helmenstine defined balanced chemical equation as 'an equation in which the no. of atoms for each elements in reaction & the total charge are same for both reactants & products'. The unbalanced chemical equation is utilized to locate a system of linear equations, which can then be solved to get stoichiometric coefficients.

A chemical equation is said to be balanced, provided that the number of atoms of each type on the left is same as number of atoms of the corresponding type on right. This leads to the concept of Stoichiometry which is defined as 'the quantitative relationship between reactants and products in a chemical equation is'. In other words, stoichiometry is the proportional relationship between two or more substances during a chemical reaction. The

ratio of moles of reactants and products is given by coefficients in balanced chemical equation.

Balancing a chemical reaction equation requires basic skills in algebra. Generally, it is known that the chemical reaction balancing problems are a mathematical problem. Chemistry students have had persistent difficulty in topics related to reaction stoichiometry, particularly concerning its application with chemical reactions. The aim of this is balancing chemical reaction equation using Gauss elimination method in matrix. We can handle any chemical reaction with specified reactants and products through using this approach.

ALGEBRAIC METHOD CHARACTERISTICS

Algebraic method is the most widely used, because it can be applied for balancing of all types of chemical reactions. Perhaps, the most significant characteristic in algebraic method is the guaranteed to obtain the solution. If the chemical reaction equation can be balanced, we will find the coefficients if cannot be balanced, in this case, we will find that there are variables more than equations, or that equations are conflicting. With other methods like inspection, for instance, we will never have a proof that the chemical equation cannot be balanced.

There is an additional characteristic for this method to be so important. PCs are extremely efficient in solving collections of simultaneous equations, for instance, Gauss elimination method. What was difficult to do in past become available, accessible, & easy to use because of the number of programs and packages built in every processor. That is why it is fit to solve a system of equations whatever the number of unknowns and equations in the blink of an eye.

HOMOGENEOUS SYSTEM

A homogeneous system of linear equations is one in which all of the constant terms are zero. A homogeneous system always has at least one solution, namely the zero vector.

For example, the following homogeneous systems:
 $\{2x - 3y = 0, -4x + 6y = 0\}$ and
 $\{5x_1 - 2x_2 + 3x_3 = 0, 6x_1 + x_2 - 7x_3 = 0, -x_1 + 3x_2 + x_3 = 0\}$

NON HOMOGENEOUS SYSTEM

A non homogeneous system of linear equation has a unique non-trivial solution if and only if its determinant is non-zero. If this determinant is zero, then system has either no non-trivial solutions.

A non-homogeneous system has an associated homogeneous system, which you get by replacing the constant term in each equation with zero.

Row Echelon Form

A matrix in row echelon form if it meets the following requirements -

- ① The first non-zero number from the leading left is always to the right of first non-zero number in row above.
- ② Rows consisting of all zeros are at bottom of the matrix.

$$\begin{bmatrix} 1 & a_0 & a_1 & a_2 & a_3 \\ 0 & 0 & 2 & a_4 & a_5 \\ 0 & 0 & 0 & 1 & a_6 \end{bmatrix}$$

This is Row echelon form. 'a' can represent any number.

Technically, the leading co-efficient can be any number. However, the majority of state that leading coefficient must be number 1.

If leading coefficient in each row is only non-zero number in that column, the matrix is said to be in reduced row-echelon form.

What is Reduced Row Echelon Form?

Reduced row echelon form is type of matrix used to solve systems of linear equations. Reduced row echelon form has four requirements:

- ① The first non-zero number in first row is 1
- ② The second row also starts with 1, which is

further to right than leading entry in the first row. For every subsequent row, the no. 1 must be further to right.

③ The leading entry in each row must be only non-zero number in its column.

④ Any non-zero rows are placed at bottom of matrix.

$$\begin{bmatrix} 1 & 0 & a_1 & 0 & b_1 \\ 0 & 1 & a_2 & 0 & b_2 \\ 0 & 0 & 0 & 1 & b_3 \end{bmatrix}$$

A 3×5 matrix is in reduced form of row echelon.

Any matrix can be transformed to reduced row echelon form, using Gaussian elimination. This is particularly useful for Solving System of Linear Equations.

GAUSSIAN ELIMINATION

Gaussian elimination is a way to find a solution to a system of linear equations. The basic idea is that to perform a mathematical operation on row and continue until only one variable is left. For example, some possible row operations are:

- Interchange any two rows
- Add two rows together
- Multiply one row by a non-zero constant.
(i.e. $\frac{1}{3}$, $-\frac{1}{5}$).

We can also perform more than one row operation at a time. For example, multiply one row by a constant and then add a result to other row.

Gaussian Elimination Example -

- Solve following system using Gaussian elimination
 $x + 5y = 7$, $-2x - 7y = 5$.

⇒ Step 1 -

convert the equation into coefficient form of matrix

$$\begin{bmatrix} 1 & 5 & 7 \\ -2 & -7 & 5 \end{bmatrix}$$

Step 2 -

Turn the numbers in bottom row into positive by adding 2 times the first row

$$\begin{bmatrix} 1 & 5 & 7 \\ 0 & 3 & 9 \end{bmatrix}$$

Step 3 -

Multiply the second row by $1/3$. This gives second leading 1

$$\begin{bmatrix} 1 & 5 & 7 \\ 0 & 1 & 3 \end{bmatrix}$$

Step 4 -

Multiply row 2 by -5 & then add this to row 1

$$\begin{bmatrix} 1 & 0 & -8 \\ 0 & 1 & 3 \end{bmatrix}$$

In first row, we have $x = -8$ & in second row $y = 3$. In this way we solve examples by using Gaussian elimination method.

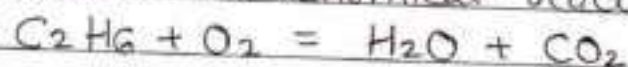
ALGEBRAIC APPROACH SOLUTION

DATE:

Indeed, balancing the chemical equations provides an excellent model of a relation between Stoichiometry basics and linear algebra. In this Section, linear algebra approach to balance chemical equation was carried out. The chemical equation are balanced here using matrix algebra by Gaussian elimination. Being able to balance a chemical reaction equation is vital skill. There are some examples of how to balance an equation.

Problem-1:

Balance the chemical reaction -



→ Solution -

The equation to balance is identified. This chemical reaction consists of three elements: Carbon (C), Hydrogen (H), Oxygen (O).

The equation to balance is identified our task is to assign the unknown coefficients (x_1, x_2, x_3, x_4) to each chemical species. A balance equation can be written for each of these elements.



The algebraic representation of balanced

$$\text{Carbon (C)} - 2x_1 = x_4$$

$$\text{Hydrogen (H)} - 6x_1 = 2x_3$$

$$\text{Oxygen} = 2x_2 = x_3 + 2x_4$$

We write these as homogeneous system

$$2x_1 - x_4 = 0$$

$$3x_1 - x_3 = 0$$

$$2x_2 - x_3 - 2x_4 = 0$$

$\therefore$ Matrix form is

$$\begin{bmatrix} 2 & 0 & 0 & -1 \\ 0 & 2 & -1 & -2 \\ 3 & 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_3 \rightarrow 2R_3 - 3R_1$$

$$\begin{bmatrix} 2 & 0 & 0 & -1 \\ 0 & 2 & -1 & -2 \\ 0 & 0 & -2 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$r < n$$

$\therefore$ It has infinitely many solution.

$$\therefore 2x_1 - x_4 = 0 \text{ --- (1)} \quad 2x_2 - x_3 - 2x_4 = 0 \text{ --- (2)} \quad -2x_3 + 3x_4 = 0 \text{ --- (3)}$$

put $x_4 = t$ ($t \neq 0$) in (3), (2) & (1)

$$-2x_3 + 3t = 0$$

$$2x_1 - t = 0$$

$$2x_2 - x_3 - 2t = 0$$

$$2x_3 = 3t$$

$$x_1 = \frac{1}{2}t$$

$$2x_2 - \frac{3}{2}t - 2t = 0$$

$$x_3 = \frac{3}{2}t$$

$$x_2 = \frac{7}{4}t$$

$$\therefore x_1 = \frac{t}{2}, \quad x_2 = \frac{7t}{4}, \quad x_3 = \frac{3t}{2}, \quad x_4 = t$$

Let choose $t = 4$

$$\therefore x_1 = \frac{4t}{2} = 2, \quad x_2 = \frac{7}{4} \times 4t = 7, \quad x_3 = \frac{3 \times 4t}{2} = 6t, \quad x_4 = 4$$

$\therefore$ The balanced chemical eqⁿ is



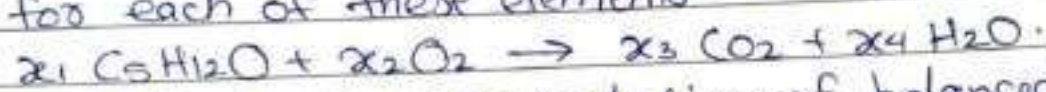
Problem - 2.

Balanced the chemical reaction $C_5H_{12}O + O_2 \rightarrow CO_2 + 8H_2O +$

→ Solution -

The equation to balance is identified. This chemical reaction consists of three elements: Carbon (C), Hydrogen (H), Oxygen (O).

The equation to balance is identified our task is to assign the unknown coefficients (x_1, x_2, x_3, x_4) to each chemical species. A balance eqⁿ can be written for each of these elements.



The algebraic representation of balanced

$$\text{Carbon (C)} = 5x_1 = x_3$$

$$\text{Hydrogen (H)} = 12x_1 = 2x_4$$

$$\text{Oxygen (O)} = x_1 + 2x_2 = 2x_3 + x_4$$

We write these as homogeneous system

$$5x_1 - x_3 = 0$$

$$12x_1 - 2x_4 = 0$$

$$x_1 + 2x_2 - 2x_3 - x_4 = 0$$

Converting it into matrix form

$$\begin{bmatrix} 5 & 0 & -1 & 0 \\ 12 & 0 & 0 & -2 \\ 1 & 2 & -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 \rightarrow \frac{1}{12} R_2 \quad \& \quad R_1 \leftrightarrow R_2$$

$$\begin{bmatrix} 1 & 0 & 0 & -2/12 \\ 5 & 0 & -1 & 0 \\ 1 & 2 & -2 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 \rightarrow R_2 - 5R_1$$

$$\begin{bmatrix} 1 & 0 & 0 & -2/12 \\ 0 & 0 & -1 & -10/12 \\ 1 & 2 & -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 \rightarrow -1R_2 \quad \& \quad R_2 \leftrightarrow R_3$$

$$\begin{bmatrix} 1 & 0 & 0 & -2/12 \\ 1 & 2 & -2 & -1 \\ 0 & 0 & 1 & 10/12 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 - R_1 \quad \& \quad \frac{1}{2} R_2$$

$$\begin{bmatrix} 1 & 0 & 0 & -2/12 \\ 0 & 1 & -1 & -5/12 \\ 0 & 0 & 1 & 10/12 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 \rightarrow R_2 - R_3$$

$$\begin{bmatrix} 1 & 0 & 0 & -2/12 \\ 0 & 1 & 0 & -15/12 \\ 0 & 0 & 1 & 10/12 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\therefore x_1 = \frac{2}{12}t \quad x_2 = \frac{15}{12}t \quad x_3 = \frac{10}{12}t \quad x_4 = t$$

put $t = 12$ (x_1, x_2, x_3, x_4 are positive)

$$\therefore x_1 = 2 \quad x_2 = 15 \quad x_3 = 10 \quad x_4 = 12$$

$\therefore$ The balanced chemical eqⁿ is



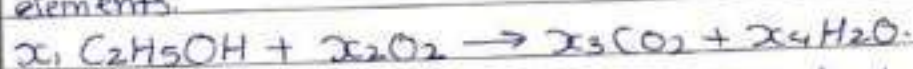
Problem - 3

Balanced the chemical reaction - $C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$

→ Solution -

The equation to balance is identified. This chemical reaction consists of three elements: Carbon (C), Hydrogen (H), Oxygen (O).

The equation to be balanced is identified our task is to assign the unknown coefficients (x_1, x_2, x_3, x_4) to each chemical species. A balance equation can be written for each of these elements.



The algebraic representation of balanced

$$\text{Carbon (C)} = 2x_1 + 0x_2 = x_3 + 0x_4$$

$$\text{Hydrogen (H)} = 6x_1 = 2x_4$$

$$\text{Oxygen (O)} = x_1 + 2x_2 = 2x_3 + x_4$$

We write these as homogeneous system

$$2x_1 - x_3 = 0$$

$$6x_1 - 2x_4 = 0$$

$$x_1 + 2x_2 - 2x_3 - x_4 = 0$$

Converting it into matrix form

$$\begin{bmatrix} 2 & 0 & -1 & 0 \\ 6 & 0 & 0 & -2 \\ 1 & 2 & -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_3 \leftrightarrow R_1$$

$$\begin{bmatrix} 1 & 2 & -2 & -1 \\ 6 & 0 & 0 & -2 \\ 2 & 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 \rightarrow -6R_1 + R_2 \quad -2R_1 + R_3$$

$$\begin{bmatrix} 1 & 2 & -2 & -1 \\ 0 & -12 & 12 & 4 \\ 0 & -4 & 3 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$-\frac{1}{12} R_2$$

$$\begin{bmatrix} 1 & 2 & -2 & -1 \\ 0 & 1 & -1 & -2/3 \\ 0 & -4 & 3 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$R_2 + R_3, \quad 2R_3 + R_1$$

$$\begin{bmatrix} 1 & 2 & -2 & -1 \\ 0 & 1 & -1 & -1/3 \\ 0 & 0 & -1 & 2/3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$-R_3$$

$$\begin{bmatrix} 1 & 2 & -2 & -1 \\ 0 & 1 & -1 & -1/3 \\ 0 & 0 & 1 & -2/3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$4R_2 + R_3$$

$$R_1 - 2R_2$$

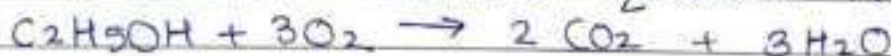
$$\begin{bmatrix} 1 & 0 & 0 & -1/3 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & -2/3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$x_1 = \frac{1}{3}t \quad x_2 = 1t \quad x_3 = \frac{2}{3}t \quad x_4 = t$$

Let, choose $t = 3$.

$$\therefore x_1 = 1 \quad x_2 = 3 \quad x_3 = 2 \quad x_4 = 3$$

$\therefore$ The balanced chemical equation is -



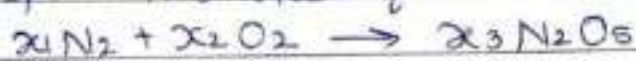
Problem - 4

Balanced the chemical reaction - $N_2 + O_2 \rightarrow N_2O_5$

→ Solution -

The equation to be balanced is identified. This chemical reaction consists of two elements: Nitrogen (N), Oxygen (O).

Now assign unknown coefficients (x_1, x_2, x_3) to each chemical species. A balanced eqⁿ can be written for each of these elements



The algebraic representation of balanced

$$\text{Nitrogen (N)} = 2x_1 = 2x_3$$

$$\text{Oxygen (O)} = 2x_2 = 5x_3$$

We write these as homogeneous system

$$2x_1 - 2x_3 = 0 \quad \& \quad 2x_2 - 5x_3 = 0$$

Converting it into matrix form

$$\begin{bmatrix} 2 & 0 & -2 \\ 0 & 2 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\frac{1}{2} R_1 \& \frac{1}{2} R_2$$

$$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & -5/2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\therefore x_1 = 1t \quad x_2 = +5/2 t \quad x_3 = t$$

Let choose $t = 2$ (1)

$$\therefore x_1 = 2 \quad x_2 = 5 \quad x_3 = 2$$

$\therefore$ The balanced chemical equation is



CONCLUSION

This work presented a formal systematic approach for balancing chemical equations. The method is based on the Gaussian elimination method and augmented matrix protocols. The actual notability of the matrices procedure as an effective method for balancing a chemical equation reaction is illustrated through different problems. In other words, the mathematical method presented in this was applicable for all cases in chemical reactions. The results indicated that there is no any contradiction between the various methods that were applied to balance the chemical reaction equation and the suggested approach.

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Subject :- Mathematics

Project Name :- Application Of System Of
Linear Equations

Project Name :-

Application of System of
Linear Equations

* Introduction :-

Linear algebra is about linear combinations. That is, using arithmetic on columns of numbers called vectors and arrays of numbers called matrices, to create new columns and arrays of numbers. Linear algebra is the study of lines and plane vector spaces and mappings that are required for linear transforms. It is a relatively young field of study, having initially been formalized in the 1800s in order to find unknowns in systems of linear equations. A linear equation is just a series of terms and mathematical operations where some terms are unknown. Linear algebra is an essential tool when working with electrical circuits. The use of matrices is considered to be an integral concept utilized by electrical engineers. Most of computer applications are based on linear algebra including solution of systems of linear equations.

Linear algebra is considered as a basic concept in the modern presentation of Geometry. It is the study of linear sets of equations & its transformation properties.

* Linear Equation :-

The equation is said to be linear if the variable terms in these equations have degree one. Linear equations are also first degree equations as it has the highest exponent of variables as one.

Geometrically, a linear equation in

i) one variable, represents a point in $\mathbb{R}$. eg- $3x = 7$

ii) two variables, represents a straight line in xy plane.
eg- $2x + 3y = 4$

iii) Three variables, represents a plane in xyz space.
eg- $2x + y - 6z = 15$

iv) Four or more variables, represents a hyperplane, which is extension of our plane in higher dimensional space.

System of Linear Equation -

A collection of linear equations with the same set of variables, represents a system of linear equations.

In fact, a system of linear equations is nothing but our good old set of simultaneous linear equations.

eg- $3x + 5y = 7$ & $2x - y = 10$, is a system of linear equations in x and y .

|| A General system of m linear equation in n variables is given by,

$$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + \dots + a_{1n}x_n = b_1$$

$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \dots + a_{2n}x_n = b_2$$

.....

$$a_{m1}x_1 + a_{m2}x_2 + a_{m3}x_3 + \dots + a_{mn}x_n = b_m$$

Where each a_{ij} & b_i are real numbers, $i=1, 2, \dots, m$
& $j=1, 2, \dots, n$ with one $a_{ij} \neq 0$ for each i
 $x_1, x_2, \dots, x_n$ are unknowns

In notation the system can be written as,

$$\sum_{j=1}^n a_{ij} x_j = b_i, \quad 1 \leq i \leq m$$

2) Matrix representation of m linear equation in n variables is given by,

$$\text{Consider, } a_1x + b_1y + c_1 = d_1$$

$$a_2x + b_2y + c_2 = d_2$$

$$a_3x + b_3y + c_3 = d_3$$

Can be written using matrices, as $AX = B$

$$\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$$

where, A is the matrix of coefficient

X is the matrix of unknowns

& B is the Matrix of constant terms

Homogeneous Equations -

A system of linear equations is homogeneous if all of the constant terms are zero.

$$a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = 0$$

$$a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = 0$$

$\vdots$

$$a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n = 0$$

A homogeneous system is equivalent to a matrix equation of the form $AX = 0$

Where, A is an $m \times n$ matrix, X is column vector with n entries and (0) zero is the zero vector with m entries

Every homogeneous system has at least one solution, known as zero or trivial solution which is obtained by assigning the value of zero to each of the variable.

Example :

$$x + 2y = 0, \quad 3x + 5y = 0, \quad 4x - y = 0$$

Solution -

Consider, $AX = 0$

$$\begin{bmatrix} 1 & 2 \\ 3 & 5 \\ 4 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$\therefore$ By $R_2 - 3R_1$ & $R_3 - 4R_1$,

$$\begin{bmatrix} 1 & 2 \\ 0 & -1 \\ 0 & -9 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\text{By } R_2 \leftrightarrow -R_3, \quad \begin{bmatrix} 1 & 2 \\ 0 & 1 \\ 0 & 9 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\text{By } R_3 - 3R_2, \begin{bmatrix} 1 & 2 \\ 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$\therefore$ The equations are, $x + 2y = 0$
 $y = 0 \Rightarrow x = 0$

Here, $r = 2$, $n = 2$ i.e. $r = n$.

Hence the system has unique solution i.e. trivial solutions
 $(x, y) = (0, 0)$.

Non-Homogeneous Equations -

A system of linear equations is non-homogeneous if all of the constant terms are non-zero

$$a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = b_1$$

$$a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = b_2$$

$$a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n = b_n$$

The non-homogeneous system is equivalent to a matrix equation of the form $AX = B$

i.e. A non-homogeneous system has an associated homogeneous system, which can be got by replacing the constant terms in each equation with zero.

Example :

$$2x + y + z = 5; \quad 3x + y - z = 7; \quad 5x + 2y = 12$$

Solution -

Consider $AX = B$

$$\begin{bmatrix} 2 & 1 & 1 \\ 3 & 1 & -1 \\ 5 & 2 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 7 \\ 12 \end{bmatrix}$$

$$\text{By } R_2 - R_1, \begin{bmatrix} 2 & 1 & 1 \\ 1 & 0 & -2 \\ 5 & 2 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 2 \\ 12 \end{bmatrix}$$

$$\text{By } R_1 \leftrightarrow R_2, \begin{bmatrix} 1 & 0 & -2 \\ 2 & 1 & 1 \\ 5 & 2 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 5 \\ 12 \end{bmatrix}$$

$$\text{By } R_2 - 2R_1, \begin{bmatrix} 1 & 0 & -2 \\ 0 & 1 & 5 \\ 0 & 2 & 10 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix}$$

$$\text{By } R_3 - 2R_2, \begin{bmatrix} 1 & 0 & -2 \\ 0 & 1 & 5 \\ 10 & 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix}$$

The last row A is zero & the row last of B is zero

- The system is consistent, solvable

Here, $r = 2$, $n = 3$, $r < n \Rightarrow$ Infinitely many solutions

& The column 2 has no pivot elements

- It has free variable & 'z', Take $z = t$

- By solving eq's $\Rightarrow x - 2z = 2 \text{ --- (I)}, z = t$

$$y + 5z = 1 \Rightarrow y = 1 - 5t$$

$$\text{eq}^n \text{ (I) becomes } \Rightarrow x = 2 + 2t$$

The solution of system is infinitely many solutions with

$$(x, y, z) = (2 + 2t, 1 - 5t, t)$$

* Row Echelon form of Matrix :-

In linear algebra, a Matrix is in row echelon form if it has a shape resulting from a Gaussian elimination. A Matrix is said to be in a Row Echelon form, if it satisfies the following conditions -

- i) All of its non-zero rows are above it row zero.
- ii) The leading coefficient of each non-zero row is to the right of the leading coefficient of the previous row.

A triangular Matrix whether it is upper or lower, always talks of elements below the diagonal or above the diagonal. It means that, a triangular matrix is defined only for a square matrix, whereas an Echelon form is for any Matrix, be it a square matrix or a non-square matrix.

Understanding the standard terminology -

1. A zero row of Matrix, is the row whose all entries are zeros.
2. A non-zero of Matrix, has atleast one non-zero entry.
3. A pivot element, also known as the leading coefficient of a row.

Example -

$$\begin{bmatrix} 2 & 2 & 7 & -1 \\ 3 & 3 & -3 & 6 \\ 1 & 1 & -1 & 2 \end{bmatrix}$$

Solution -

$$\text{let } A = \begin{bmatrix} 2 & 2 & 7 & -1 \\ 3 & 3 & -3 & 6 \\ 1 & 1 & -1 & 2 \end{bmatrix}$$

$$\therefore \text{By } R_1 \leftrightarrow R_3, \text{ gives } \begin{bmatrix} 1 & 1 & -1 & 2 \\ 3 & 3 & -3 & 6 \\ 2 & 2 & 7 & -1 \end{bmatrix}$$

By $\frac{1}{3} R_2$, gives
$$\begin{bmatrix} 1 & 1 & -1 & 2 \\ 1 & 1 & -1 & 2 \\ 2 & 2 & 7 & -1 \end{bmatrix}$$

By $R_2 - R_1$ & $R_3 - 2R_1$,
$$\begin{bmatrix} 1 & 1 & -1 & 2 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 9 & -5 \end{bmatrix}$$

By $R_2 \leftrightarrow R_3$,
$$\begin{bmatrix} 1 & 1 & -1 & 2 \\ 0 & 0 & 9 & -5 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Thus, a row echelon form of the given matrix with pivot elements circled, is given by

$$\begin{bmatrix} \textcircled{1} & 1 & -1 & 2 \\ 0 & 0 & \textcircled{9} & -5 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

= The Matrix is in Row Echelon form.

Some other examples are of row Echelon form is

$$\begin{bmatrix} \textcircled{3} & 2 & 3 \\ 0 & \textcircled{1} & 2 \\ 0 & 0 & -2 \end{bmatrix}, \begin{bmatrix} 0 & \textcircled{1} & 2 \\ 0 & 0 & \textcircled{5} \\ 0 & 0 & 0 \end{bmatrix}$$

and the Matrix is in the form of $\begin{bmatrix} a & 0 & 0 \\ d & b & 0 \\ e & f & c \end{bmatrix}$ is not a row echelon form.

* Gaussian Elimination Method to Solve System of Linear Equations :-

Gauss elimination Method is used to solve a system of linear equations. It is also known as the row reduction algorithm for solving linear equations systems.

In this Method we follow the following steps :-

- 1] Write down the given system of linear equations in the Matrix form $AX = B$
- 2] Apply row transformations to this Matrix equations so as to reduce A to in row Echelon form A_1 , in the same order will be applied to B to change in B_1 .
- 3] If the reduced Matrix has all non zero rows or at least one zero row in the Matrix but the element corresponding to this row in the Matrix B , is also zero then system is Consistent, i.e. the system has a solution & If the corresponding to this row in the Matrix B , is non-zero then the system is inconsistent i.e. system has no solution.
- 4] Circle the pivot elements of A_1 & note down no. of variables of the system. The total no. of Pivot elements as r & the no. of variable as n .
- 5] This step is in two parts

i) If $r = n$, then the system has a Unique solution, which can be found by using back substitution.

eg
$$\begin{bmatrix} 1 & -1 \\ 0 & 2 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 \\ 5 \\ 0 \end{bmatrix}$$

Here $r = 2$, $n = 2$

$\therefore r = n$, Hence the system has Unique solution.

ii) If $r < n$, then there will be a few columns in this case, which do not have a pivot element.

a) Label all the columns of A with corresponding variables.

b) Mark 0 columns without pivot elements.

c) The variable related to this column are called 'free' variable.

These free variables contribute to infinite solutions.

eg.
$$\begin{bmatrix} \textcircled{1} & -2 & 3 & 1 \\ 0 & 0 & \textcircled{1} & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$$

Here $r = 2$, $n = 4$, $r < n$

In the matrix A the column of y & w do not have a pivot element. Hence y & w are free variables.

Let $y = t$, $w = s$

∴ The system has infinitely many solutions.

* Application of Linear Algebra - Electrical Circuits

Electrical Circuit is nothing but just a combination of transistor, capacitor, diodes, etc. including some logic gates. Each component has its own specification & through which we get to know what currents & voltages are. An electrical circuit is a path in which electrons from a voltage or current source flow. Linear algebra is mostly used in electrical circuits when ever there is system of linear equation. One of the concept of linear algebra various electrical circuits solution like Kirchhoff's law, Ohm's law are conceptually one's linear algebra.

There are two law which are used in electrical circuits. One -

1) Ohm's law - It state that, the current through a conductor is directly proportional to the voltage & inversely proportional to resistance.

$$\text{i.e. } V = IR$$

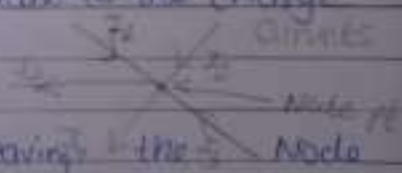
2) Kirchhoff's Law -

i) 1st law - According to Kirchhoff's Current law, the total current entering a junction or a node is equal to the charge leaving the node as no charge is lost.

E.g. from diagram

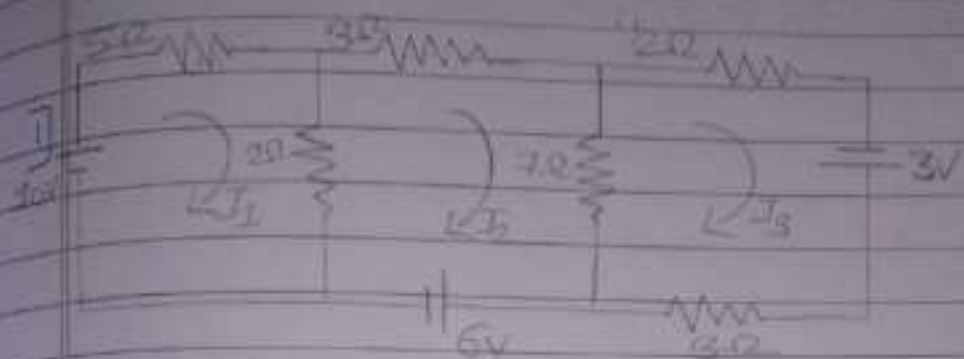
The current entering the node = Current leaving the node

$$I_1 + I_2 + I_3 = I_4 + I_5$$



ii) 2nd law - It state that around every loop, the algebraic sum of the voltage gains must be equal to the algebraic sum of voltage drops.

Some Examples related to Electric Circuits -



Solutions -

To find the values of currents, I_1 , I_2 & I_3

By Applying Kirchhoff's Voltage law.

In loop 1, $(5+2)I_1 - 2I_2 = 10$

$$\therefore 7I_1 - 2I_2 = 10 \quad \text{--- (I)}$$

In loop 2, $-2I_1 + (2+3+7)I_2 - 7I_3 = -6$

$$-2I_1 + 12I_2 - 7I_3 = -6 \quad \text{--- (II)}$$

In loop 3, $-7I_2 + (7+3+2)I_3 = 3$

$$-7I_2 + 12I_3 = 3 \quad \text{--- (III)}$$

$\therefore$ From $RI = V$

$$\begin{bmatrix} 7 & -2 & 0 \\ -2 & 12 & -7 \\ 0 & -7 & 12 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10 \\ -6 \\ 3 \end{bmatrix}$$

$\therefore$ To convert it into row Echelon form;

$$\text{By } \frac{1}{7} R_1, \begin{bmatrix} 1 & -2/7 & 0 \\ -2 & 12 & -7 \\ 0 & -7 & 12 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10/7 \\ -6 \\ 3 \end{bmatrix}$$

$$\text{By } R_2 + 2R_1, \begin{bmatrix} 1 & -2/7 & 0 \\ 0 & 80/7 & -7 \\ 0 & -7 & 12 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10/7 \\ -22/7 \\ 3 \end{bmatrix}$$

$$R_1 \xrightarrow{7} R_2 : \begin{bmatrix} 1 & -2/7 & 0 \\ 0 & 1 & -49/80 \\ 0 & 7 & 12 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10/7 \\ -11/40 \\ 3 \end{bmatrix}$$

$$R_1 \xrightarrow{R_3 - 7R_2} : \begin{bmatrix} 1 & -2/7 & 0 \\ 0 & 1 & -49/80 \\ 0 & 0 & 1303/80 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10/7 \\ -11/40 \\ 197/40 \end{bmatrix}$$

$$R_1 \xrightarrow{R_3 \left(\frac{80}{1303} \right)} : \begin{bmatrix} 1 & -2/7 & 0 \\ 0 & 1 & -49/80 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10/7 \\ -11/40 \\ 394/1303 \end{bmatrix}$$

$$R_1 \xrightarrow{R_2 + \frac{49}{80} R_3} : \begin{bmatrix} 1 & -2/7 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10/7 \\ -117/1303 \\ 394/1303 \end{bmatrix}$$

$$R_1 \xrightarrow{R_1 + \frac{2}{7} R_2} : \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 1828/1303 \\ -117/1303 \\ 394/1303 \end{bmatrix}$$

∴ The equations are, $I_1 = \frac{1828}{1303}$

$$\therefore I_1 = 1.4029 \text{ amp}$$

$$I_2 + I_3 = \frac{-117}{1303}$$

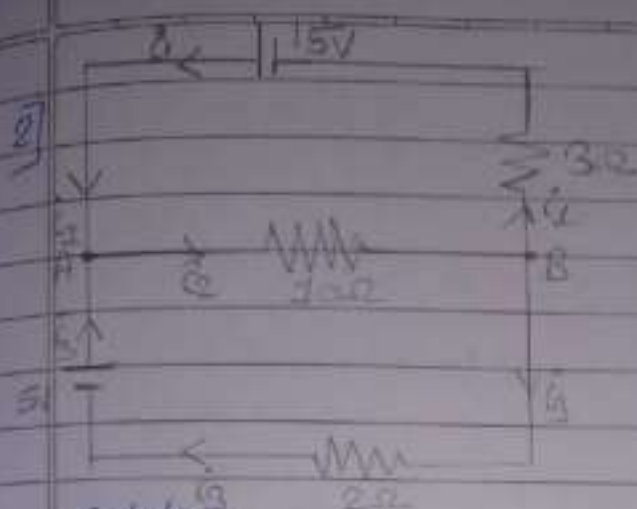
$$I_3 = \frac{394}{1303}$$

$$\Rightarrow I_2 + 0.302 = \frac{-117}{1303}$$

$$\therefore I_3 = 0.3023 \text{ amp}$$

$$\Rightarrow I_2 = -0.392 \text{ amp}$$

Solving by back substitution, we get $I_1 = 1.402 \text{ amp}$,
 $I_2 = -0.392 \text{ amp}$ & $I_3 = 0.3023$.



Solution -

To find the values of I_1 , I_2 & I_3

By Applying Kirchhoff's Voltage law,

By 1st law, $i_1 - i_2 + i_3 = 0$ (At Node A)

$-i_1 + i_2 - i_3 = 0$ (At Node B)

By 2nd law, $3i_1 + i_2 = 15$ (top loop)

$i_2 + 2i_3 = 5$ (bottom loop)

∴ From $RI = V$

$$\begin{bmatrix} 1 & -1 & 1 \\ -1 & 1 & -1 \\ 3 & 1 & 0 \\ 0 & 1 & 2 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 15 \\ 5 \end{bmatrix}$$

By $R_2 + R_1$ & $R_3 - 3R_1$

$$\begin{bmatrix} 1 & -1 & 1 \\ 0 & 0 & 0 \\ 0 & 4 & -3 \\ 0 & 1 & 2 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 15 \\ 5 \end{bmatrix}$$

By $R_2 \leftrightarrow R_4$

$$\begin{bmatrix} 1 & -1 & 1 \\ 0 & 1 & 2 \\ 0 & 4 & -3 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \\ 15 \\ 0 \end{bmatrix}$$

$$B_3 R_3 - 4R_2 \quad \begin{bmatrix} 1 & -1 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & -11 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \\ -5 \\ 0 \end{bmatrix}$$

∴ The equations are, $i_1 - i_2 + i_3 = 0$ — (I)

$$i_2 + 2i_3 = 5 \quad \text{— (II)}$$

$$-11i_3 = -5$$

$$i_3 = \frac{5}{11} \quad \boxed{\therefore i_3 = 0.454}$$

$$\therefore \text{eqn (II)} \Rightarrow i_2 + 2(0.454) = 5$$

$$\Rightarrow \boxed{i_2 = 4.091 \text{ amp}}$$

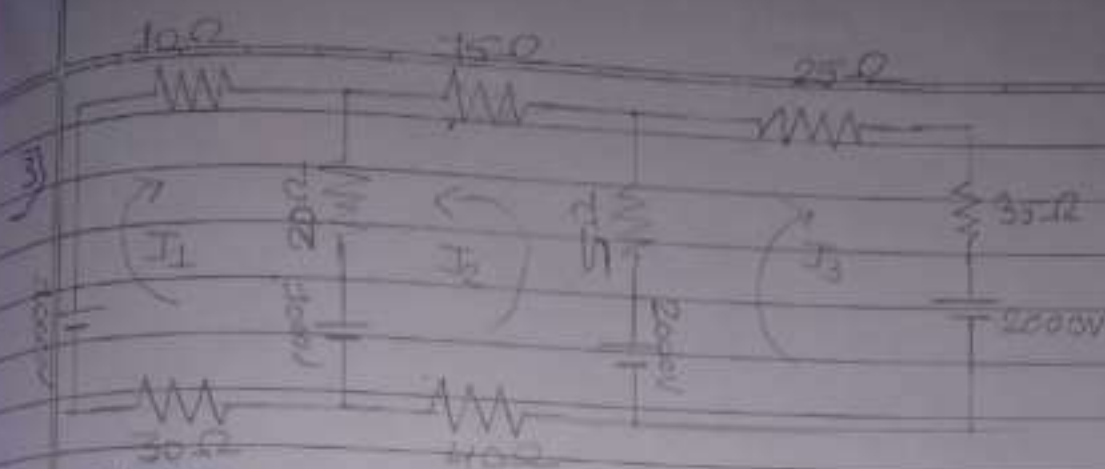
$$\text{eqn (I)} \Rightarrow i_1 - 4.091 + 0.454 = 0$$

$$\Rightarrow i_1 = 4.091 - 0.4545$$

$$\boxed{i_1 = 3.63 \text{ amp}}$$

∴ By solving back substitution method, we get

$$i_1 = 3.63 \text{ amp}, \quad i_2 = 4.09 \text{ amp}, \quad \& \quad i_3 = 0.45 \text{ amp}$$



Solution -

To find the value of currents I_1 , I_2 & I_3 .

By Applying Kirchhoff's Voltage law,

In loop 1, $(30+20+10)I_1 + 20I_2 = 1000 - 1000$
 $\therefore 60I_1 + 20I_2 = 0 \quad \dots (i)$

In loop 2, $20I_1 + (40+20+15+5)I_2 + 5I_3 = 2000 - 1000$
 $\therefore 20I_1 + 80I_2 + 5I_3 = 1000 \quad \dots (ii)$

In loop 3, $5I_2 + (5+25+35)I_3 = 2000 - 2000$
 $\therefore 5I_2 + 65I_3 = 0 \quad \dots (iii)$

from $RI = V$

$$\begin{bmatrix} 60 & 20 & 0 \\ 20 & 80 & 5 \\ 0 & 5 & 65 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 1000 \\ 0 \end{bmatrix}$$

$$R_3 \frac{1}{60} R_1, \begin{bmatrix} 1 & 1/3 & 0 \\ 20 & 80 & 5 \\ 0 & 5 & 65 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 1000 \\ 0 \end{bmatrix}$$

$$R_3 R_2 - 20R_1, \begin{bmatrix} 1 & 1/3 & 0 \\ 0 & 220/3 & 5 \\ 0 & 5 & 65 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 150/11 \\ 0 \end{bmatrix}$$

$$R_3 \frac{3}{220} R_2, \begin{bmatrix} 1 & 1/3 & 0 \\ 0 & 1 & 3/44 \\ 0 & 5 & 65 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 150/11 \\ 0 \end{bmatrix}$$

$$R_1 R_3 - 5R_2, \begin{bmatrix} 1 & 1/3 & 0 \\ 0 & 1 & 3/44 \\ 0 & 0 & 2845/44 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 150/11 \\ -750/11 \end{bmatrix}$$

$$R_1 \left(\frac{44}{2845} \right) R_3, \begin{bmatrix} 1 & 1/3 & 0 \\ 0 & 1 & 3/44 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 150/11 \\ -600/569 \end{bmatrix}$$

$$R_1 R_2 - \frac{3}{44} R_3, \begin{bmatrix} 1 & 1/3 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 7800/569 \\ -600/569 \end{bmatrix}$$

$$R_1 R_1 - \frac{1}{3} R_2, \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} -2600/569 \\ 7800/569 \\ -600/569 \end{bmatrix}$$

$\therefore$ The equations are, $I_1 = \frac{-2600}{569}$

$$\boxed{\therefore I_1 = -4.56 \text{ amp}}$$

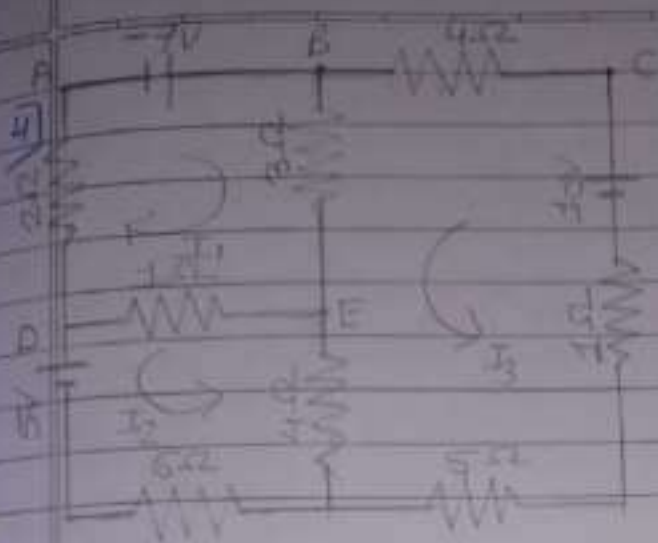
$$I_2 = \frac{7800}{569}$$

$$I_3 = \frac{-600}{569}$$

$$\boxed{\therefore I_2 = 13.70 \text{ amp}}$$

$$\boxed{I_3 = -1.05 \text{ amp}}$$

Solving by back substitution, we get $I_1 = -4.56 \text{ amp}$,
 $I_2 = 13.70 \text{ amp}$ & $I_3 = -1.05 \text{ amp}$



Solution -

To find the value of currents I_1 , I_2 & I_3

$\therefore$ By Applying Kirchhoff's Voltage law,

In loop 1, $(2+1+3)I_1 + I_2 + 3I_3 = 7$ (i)
 $6I_1 + I_2 + 3I_3 = 7$

In loop 2, $I_1 + (6+4+1)I_2 - 4I_3 = -5$ (ii)
 $I_1 + 11I_2 - 4I_3 = -5$

In loop 3, $3I_1 - 4I_2 + (4+1+4+3+5)I_3 = 10$ (iii)
 $3I_1 - 4I_2 + 17I_3 = 10$

$\therefore$ From $RI = V$

$$\begin{bmatrix} 6 & 1 & 3 \\ 1 & 11 & -4 \\ 3 & -4 & 17 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 7 \\ -5 \\ 10 \end{bmatrix}$$

$$R_2 \rightarrow \frac{1}{6} R_1, \begin{bmatrix} 1 & 1/6 & 1/2 \\ 1 & 11 & -4 \\ 3 & -4 & 17 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 7/6 \\ -5 \\ 10 \end{bmatrix}$$

$$R_2 \rightarrow R_2 - R_1 \text{ \& } R_3 - 3R_1, \begin{bmatrix} 1 & 1/6 & 1/2 \\ 0 & 65/6 & -9/2 \\ 0 & -9/2 & 13/2 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 7/6 \\ -37/6 \\ 13/2 \end{bmatrix}$$

$$R_1 \left(\frac{1}{65} \right) R_2 \rightarrow \begin{bmatrix} 1 & 1/6 & 1/2 \\ 0 & 1 & -27/65 \\ 0 & -9/2 & 31/2 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 7/6 \\ -37/65 \\ 13/2 \end{bmatrix}$$

$$R_1 R_3 + \frac{9}{2} R_2 \rightarrow \begin{bmatrix} 1 & 1/6 & 1/2 \\ 0 & 1 & -27/65 \\ 0 & 0 & 386/65 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 7/6 \\ -37/65 \\ 256/65 \end{bmatrix}$$

$$R_1 \left(\frac{65}{386} \right) R_3 \rightarrow \begin{bmatrix} 1 & 1/6 & 1/2 \\ 0 & 1 & -27/65 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 7/6 \\ -37/65 \\ 128/443 \end{bmatrix}$$

$$R_1 R_2 + \frac{27}{65} R_3 \rightarrow \begin{bmatrix} 1 & 1/6 & 1/2 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 7/6 \\ -199/443 \\ 128/443 \end{bmatrix}$$

$$R_1 R_1 - \frac{1}{6} R_2 \rightarrow \begin{bmatrix} 1 & 0 & 1/2 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 550/443 \\ -199/443 \\ 128/443 \end{bmatrix}$$

$$R_1 2R_1 \rightarrow \begin{bmatrix} 2 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 1100/443 \\ -199/443 \\ 128/443 \end{bmatrix}$$

∴ The eqⁿ are,

$$2I_1 + I_3 = \frac{1100}{443}$$

$$I_2 = \frac{-199}{443}$$

$$\therefore I_2 = -0.449 \text{ amp}$$

$$I_3 = \frac{128}{443}$$

$$\therefore I_3 = 0.288 \text{ amp}$$

$$2I_1 = \frac{1100}{443} - 0.288 \Rightarrow I_1 = \left(\frac{1100}{443} - \frac{128}{443} \right) \frac{1}{2}$$

$$\therefore I_1 = 1.097 \text{ amp}$$

By solving Back substitution we get, $I_1 = 1.09 \text{ amp}$, $I_2 = -0.44 \text{ amp}$, $I_3 = 0.288 \text{ amp}$.

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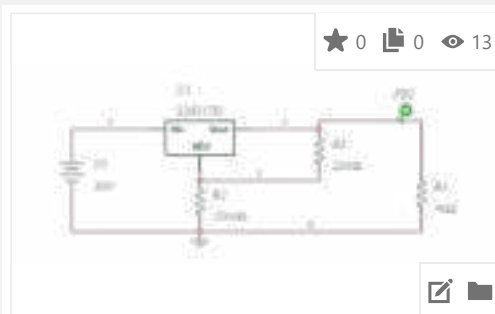
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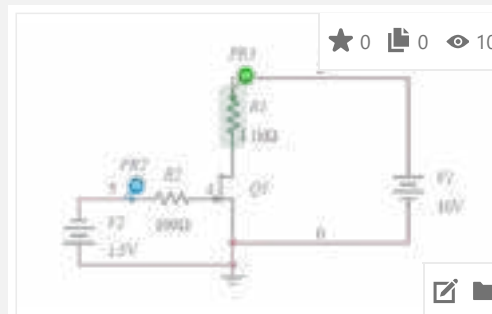
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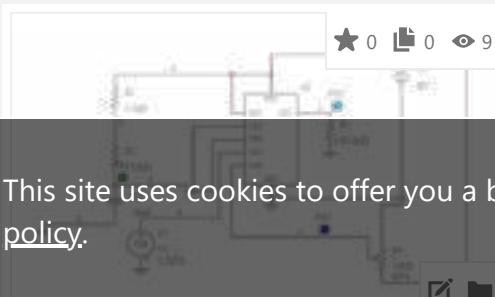
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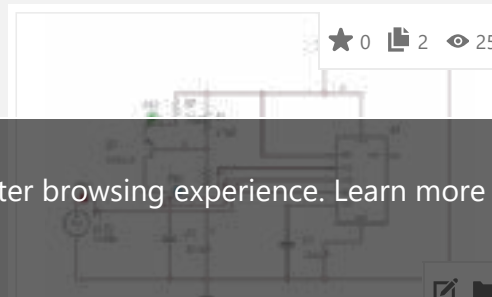
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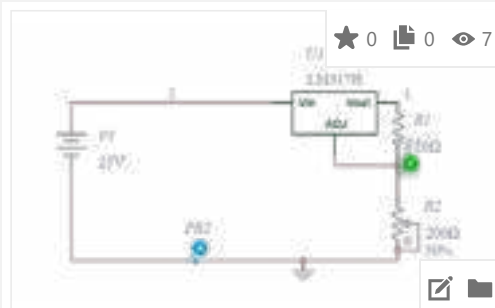
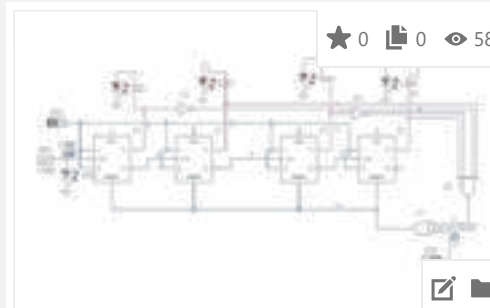
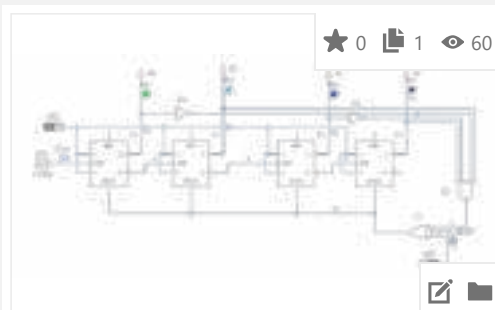
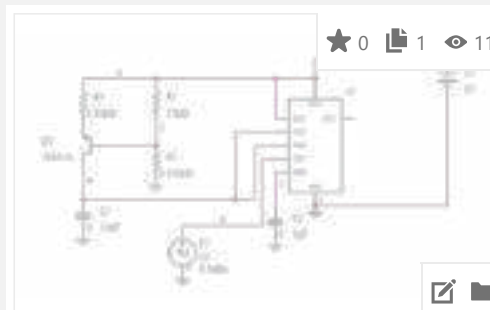
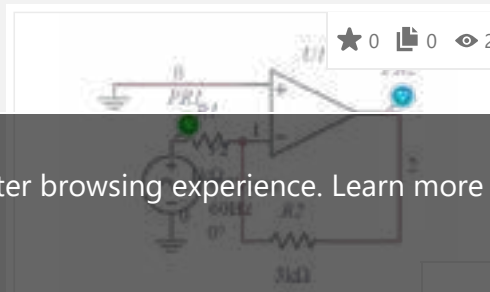
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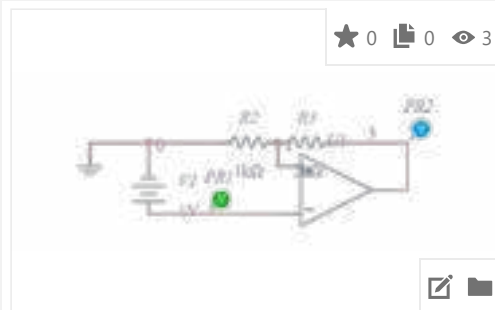
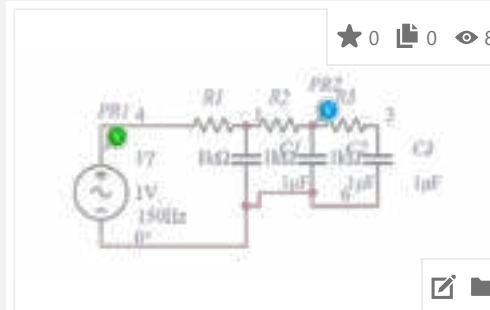
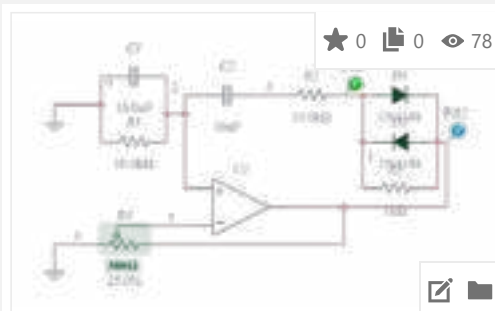
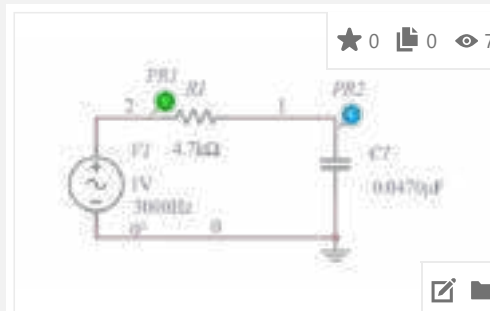
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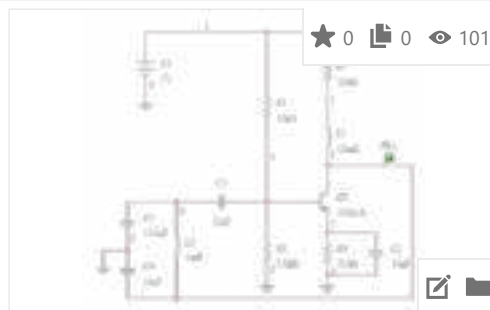


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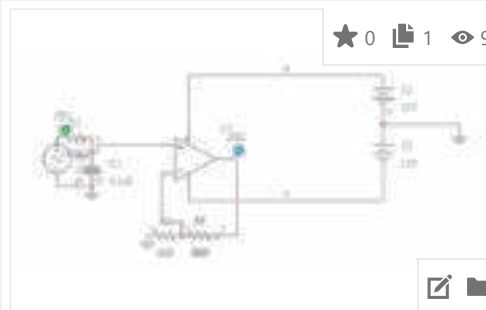
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J.S.M. College, Alibag-Raigad

Avishkar Research Convention Report – 2021-22

Basic Intension of Avishkar Research Convention is to develop research culture and Scientific temper among students, scholar and teachers from undergraduate to doctoral level in the state of Maharashtra. This activity also helps to develop skill, review new dimensions of explored areas of enquiry.

This year i.e., 2021 -22, J.S.M. College is submitted online research projects to University of Mumbai. Total 15 Projects and 34 students were participated in AvishkarResearch Convention.

Details are as follows:

Sr. No.	Category	Level	No. of Research Project	Total No. of students
1	Humanities, Languages and Fine Arts	UG	5	12
2	Humanities, Languages and Fine Arts	PG	1	1
3	Pure Sciences	UG	5	12
4	Pure Sciences	PG	3	7
5	Agriculture and AnimalHusbandry	UG	1	2
Total			15	34



PRINCIPAL
Dr. Anurag D. Kulkarni, Arts,
J. B. Dadasaheb Kore and
Jyoti Dadasaheb Kore Commerce
College, Alibag-402 301, Dist. Raigad





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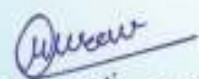
Research Convention: 2021-22

SELECTION ROUND

(District/Zonal Level Research Proposal Competition)

Certificate of Participation

This is to certify that **Dr. Sonali Patil** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **Bioluminescence** which was submitted by her student **Ms. muley Mahati** in **Pure Sciences** category and **UG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


Dr. (Mrs.) Minakshi Gurav
OSD,
Avishkar Research Convention,
University of Mumbai


Dr. Sunil Patil
Director,
Department of Students' Development,
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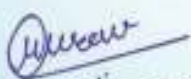
Research Convention: 2021-22

SELECTION ROUND

(District/Zonal Level Research Proposal Competition)

Certificate of Participation

This is to certify that **Dr. Simantini Rajan Thakur** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **DESALINATION** which was submitted by her student **Ms. Naik Pruthvi** in **Pure Sciences** category and **UG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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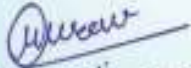
Research Convention: 2021-22

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Certificate of Participation

This is to certify that **Mr. Kapil Mahadeo Kulkarni** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **A Study of the Impact of Online Teaching-Learning on Students' Language Proficiency** which was submitted by his student **Mr. Zinje Shreyas** in **Humanities, Languages and Fine Arts** category and **UG** level for the **Selection Round of 16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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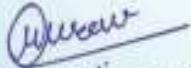
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This is to certify that **Dr. Jayshree Patil** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **MAKING ROADS IN RAIGAD BY REUSING PLASTIC** which was submitted by her student **Ms. Nagaonkar Pradnya** in **Pure Sciences** category and **PG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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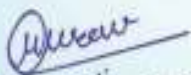
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This is to certify that **Dr. Jayshree Patil** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **Health benefits and need for plantation of white Onions in Alibag.** which was submitted by her student **Mr. Nagaonkar Shriyash** in **Pure Sciences** category and **UG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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This is to certify that **Santosh Laxman Hake** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **PRODUCTION OF NATURAL ANTISEPTIC CREAM** which was submitted by his student **Ms. Mokal Vedanka** in **Pure Sciences** category and **UG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.

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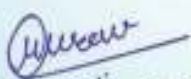
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This is to certify that **Sanit Krishna Mhatre** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **CHOOSING NATURAL PERFUMES OVER SYNTHETIC** which was submitted by his student **Ms. Mhatre Siddhi** in **Pure Sciences** category and **PG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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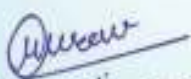
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This is to certify that **Vinayak Dattatrey Thakur.** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **PREPARATION OF SOAP BY USING ESSENTIAL OILS EXTRACTED FROM NATIVE VEGETATION** which was submitted by his student **Ms. Dalvi Iqra** in **Pure Sciences** category and **PG** level for the **Selection Round of 16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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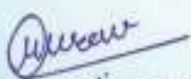
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This is to certify that **Dr. Sunil K. Anand** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **Ichthyofaunal diversity of Alibag Fish Landing Centre**, which was submitted by his student **Mr. undire Shubham** in **Agriculture and Animal Husbandry** category and **UG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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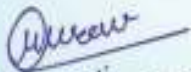
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This is to certify that **Prof. Jayesh Suresh Mhatre** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **अलिबाग परिसरातील आगरी बोलीचा भाषावैज्ञानिक अभ्यास** which was submitted by his student **Ms. Thakur Tanvi** in **Humanities, Languages and Fine Arts** category and **UG** level for the **Selection Round of 16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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This is to certify that **Mr. Advait Chandrakant Ghatpande** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **Fauna of JSM college Alibag Campus.** which was submitted by his student **Ms. patil. Tanvi** in **Pure Sciences** category and **UG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.

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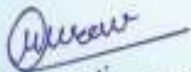
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This is to certify that **Prof. Jayesh Suresh Mhatre** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **इंग्रजी-हिंदी भाषांतून मराठीत भाषांतरित झालेल्या जाहिरातीतील भाषा.** which was submitted by his student **Ms. dongre Vedashree** in **Humanities, Languages and Fine Arts** category and **UG** level for the **Selection Round of 16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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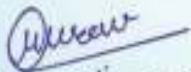
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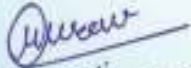
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Certificate of Participation

This is to certify that **Prof. Surabhi Umesh Wani** of **Smt. Indirabai G. Kulkarni Arts College, J. B. Sawant Science College and Sau. Janakibai Dhondo Kunte Commerce College, Alibaug (JSM College)** has guided a research proposal titled **अलिबाग परिसरातील कोळी बोली-एक अभ्यास** which was submitted by her student **Mr. patil Swarup** in **Humanities, Languages and Fine Arts** category and **UG** level for the **Selection Round** of **16th Inter-Collegiate / Institute / Department Avishkar Research Convention: 2021-22** for zone.


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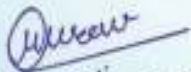
Research Convention: 2021-22

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April 25, 2022



SWAYAM-NPTEL Local Chapter

S.no	Name	Email Id	Course Id	CourseName	College Roll Number	Mobile Number	City	Profession	Qualification	Degree	Department
1	Ankur Rameshwar Pawashe	ankurpawashe2504@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-82	+91 77984 00391	Alibag	student	pre_university	science	Chemistry
2	Anuja Arvind Mhatre	anujamhatre412@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-35	+91 92737 97166	Alibag	student	pre_university	science	Chemistry
3	Anushka Suhas Kathe	anushkaskathe@gmail.com	noc21-ma50	Linear Algebra	GS-225	+91 75073 01649	Alibag	student	pre_university	science	Mathematics
4	Anushka Suhas Kathe	anushkaskathe@gmail.com	noc21-ma61	Calculus Of Several Real Variables	GS-225	+91 75073 01649	Alibag	student	pre_university	science	Mathematics
5	Apeksha Anil Patil	apekshapatil569@gmail.com	noc21-cy32	Introductory Organic Chemistry I	Gs 217	+91 76200 39923	Alibag	student	bachelor3yr	science	Chemistry
6	Avishkar bandu thale	avishkar.bthale45@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS 218	+91 81696 05494	Alibag	student	pre_university	science	Chemistry
7	Rugved Dattaram Bhagat	bahgatrugved123@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS63	+91 95030 63966	Alibag	student	pre_university	science	Chemistry
8	Tejas Yedam Bharsat	bharsattejas@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-68	+91 78209 54258	Alibag	student	pre_university	science	Chemistry
9	Tejas Yedam Bharsat	bharsattejas@gmail.com	noc21-cy46	Introductory Organic Chemistry II	GS-68	+91 78209 54258	Alibag	student	pre_university	science	Chemistry
10	Divya Bipin Peke	divyapeke@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-227	+91 73859 69978	Alibag	student	high_school	science	Chemistry
11	Durga vinayak Jadhav	durgajadhav185@gmail.com	noc21-cy32	Introductory Organic Chemistry I	Gs 83	+91 72491 75811	Alibag	student	high_school	science	Chemistry
12	Vedant Govind Gadre	gadrevedant954@gmail.com	noc21-ph25	Solar Photovoltaics Fundamentals, Technology And Applications	FS13	+91 96235 51473	Alibag	student	pre_university	science	Physics
13	Gauri Abhay Lonkar	gauri15abhay@gmail.com	noc21-ma50	Linear Algebra		+91 94212 54794	Alibag	faculty	masters		Mathematics
14	Gauri Abhay Lonkar	gauri15abhay@gmail.com	noc21-ma61	Calculus Of Several Real Variables		+91 94212 54794	Alibag	faculty	masters		Mathematics
15	Jayashree Shailesh Patil	jayupatil25@gmail.com	noc21-cy32	Introductory Organic Chemistry I		+91 94206 45446	Alibag	faculty	doctoral		Chemistry
16	Jayashree Shailesh Patil	jayupatil25@gmail.com	noc21-cy42	Reagents In Organic Synthesis		+91 94206 45446	Alibag	faculty	doctoral		Chemistry
17	Jayashree Shailesh Patil	jayupatil25@gmail.com	noc21-cy43	Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries		+91 94206 45446	Alibag	faculty	doctoral		Chemistry
18	Sonal jadhav	jsonal2019@gmail.com	noc21-mg76	Cost Accounting	Ge-68	+91 77983 06571	Alibag	student	bachelor4yr	commerce_management	Commerce
19	Jui uday nagavkar	juinagavkar@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-54	+91 83172 31772	Alibag	student	pre_university	science	Chemistry
20	Kaushal patil	kaushalpatil924@gmail.com	noc21-cy32	Introductory Organic Chemistry I	Gs64	+91 72768 53247	Alibag	student	pre_university	science	Chemistry
21	Khushi watekar	khushiwatekar@gmail.com	noc21-cy32	Introductory Organic Chemistry I	J. S. M college alibag Maharashtra (gs-78)	+91 96371 61434	Alibag	student	pre_university	science	Chemistry
22	Krutik Vijay Mhatre	krutikmhatre76676@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-203	+91 95112 97443	Alibag	student	pre_university	science	Chemistry
23	Mahati Milin Muley	mahatimuley24@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS 84	+91 86008 27206	Alibag	student	high_school	science	Chemistry
24	Manasi Vijay Mhatre	manasim946@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-56	+91 95796 96645	Alibag	student	pre_university	science	Chemistry
25	ANIKET PRAKASH MANWATKAR	manwatkar.aniket@gmail.com	noc21-cy42	Reagents In Organic Synthesis	FPS 10	+91 80107 70390	Alibag	student	bachelor3yr	science	Chemistry
26	Mihir Mahendra Mhatre	mihirmhatre08092002@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS212	+91 72640 27829	Alibag	student	pre_university	science	Chemistry

College Roll Number					Mobile Number						
S.no	Name	Email Id	Course Id	CourseName	College Roll Number	Mobile Number	City	Profession	Qualification	Degree	Department
27	More Manasi Sanjay	moremanasi5@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS49	+91 70587 71022	Alibag	student	pre_university	science	Chemistry
28	Mrunmay Sunil Shahabajkar	mrunmayshahabajkar2002@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS53	+91 83085 98826	Alibag	student	pre_university	science	Chemistry
29	Dipeeka vinod naik	naikdipeekavinod@gmail.com	noc21-cy28	Analytical chemistry	GS- 02	+91 94038 50026	Alibag	student	pre_university	science	Chemistry
30	Dipeeka vinod naik	naikdipeekavinod@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS- 02	+91 94038 50026	Alibag	student	pre_university	science	Chemistry
31	Nidhi Pramod Naik.	nidhinaikpra@gmail.com	noc21-ma44	Introduction to Abstract and Linear Algebra	GS 1	+91 90490 71369	Alibag	student	pre_university	science	Mathematics
32	Nidhi Pramod Naik.	nidhinaikpra@gmail.com	noc21-ma50	Linear Algebra	GS 1	+91 90490 71369	Alibag	student	pre_university	science	Mathematics
33	Nidhi Pramod Naik.	nidhinaikpra@gmail.com	noc21-ma61	Calculus Of Several Real Variables	GS 1	+91 90490 71369	Alibag	student	pre_university	science	Mathematics
34	Khopatkar Omkar mangesh	omkarkhopatkar12@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-214	+91 93700 69564	Alibag	student	high_school	science	Chemistry
35	Omkar Sudhir Mhatre	omkarmhatre745@gmail.com	noc21-cy32	Introductory Organic Chemistry I	Gs-43	+91 88055 41033	Alibag	student	pre_university	science	Chemistry
36	Avantika rajesh shivade	parishivade1234@gmail.com	noc21-cy42	Reagents In Organic Synthesis	FPS 06	+91 91466 54757	Alibag	student	masters	science	Chemistry
37	Shwetambari Sunil Patil	patil.shwetambari27@gmail.com	noc21-cy42	Reagents In Organic Synthesis	FPS 08	+91 80879 31774	Alibag	student	masters	science	Chemistry
38	SOJWAL SADANAND PATIL	patilsojwal1629@gmail.com	noc21-cy32	Introductory Organic Chemistry I	jsm collage alibag	+91 70389 21477	Alibag	student	high_school	science	Chemistry
39	Piyush Deshmukh	pd501913@gmail.com	noc21-cs67	Programming, Data Structures And Algorithms Using Python	GCS07	+91 93739 31357	Alibag	student	pre_university	science	Computer Science
40	Prachiti Anant Patil	prachiti.patil03@gmail.com	noc21-cy32	Introductory Organic Chemistry I	GS-90	+91 92607 22689	Alibag	student	pre_university	science	Chemistry
41	Pruthvi Nilesh Naik	pruthvinaikthal@gmail.com	noc21-cy32	Introductory Organic Chemistry I	Ga 202	+91 93254 65629	Alibag	student	pre_university	science	Chemistry
42	Ritesh Laxman Mahadik	riteshmahadik91@gmail.com	noc21-cy42	Reagents In Organic Synthesis	FPS 11	+91 80875 17482	Alibag	student	masters	science	Chemistry
43	SAYALI BALNATH PATIL	rsayali2527@gmail.com	noc21-bt24	Biomicrofluidics	EPS-04	+91 77982 63907	Alibag	student	masters	science	Chemistry
44	SAYALI BALNATH PATIL	rsayali2527@gmail.com	noc21-bt28	Bioreactors	EPS-04	+91 77982 63907	Alibag	student	masters	science	Chemistry
45	SAYALI BALNATH PATIL	rsayali2527@gmail.com	noc21-bt30	Biomedical nanotechnology	EPS-04	+91 77982 63907	Alibag	student	masters	science	Chemistry
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