Criterion 3 - Research, Innovations and Extension

3.5: Collaboration

3.5.1 Number of functional MoUs/linkages with institutions/ industries in India and abroad for internship, on-the-job training, project work, student / faculty exchange and collaborative research during the last five years.

List Of Documents Summary Of The Functional Mous/Linkage/Collaboration Indicating Start Date, End Date, Nature Of Collaboration Etc.

Sripat Singh College

(Estd. 1949. Govt. Sponsored)

P.O.: Jiaganj • Dist. Murshidabad • West Bengal-742123

Sripat Singh College

(Estd. 1949. Govt. Sponsored)
P.O.: Jiaganj • Dist. Murshidabad • West Bengal-742123
Phone: (03483) 255351, Tele Fax: (03483) 256961,
www.sripatsinghcollege.edu.in E-mail: sscollege2009@gmail.com

Academic linkage and MoUs with Institutions/Industries

Sl. No.	***Name of the MoU/ Linkage***	***Name of the collaborating institution with whom the MoU / collaboration / linkage is made***	***Date of Signature/ Start Date***	***Duration/End Date of MoU / collaboration / linkage***
01	Academic MoU	**Nabagram Amar Chand Kundu College**	21-05-2018	Continuing
02	Academic MoU	**Subhas Chandra Bose Centenary College**	21-05-2018	Continuing
03	Academic MoU	**Lalgola College**	21-05-2018	Continuing
04	Academic MoU	**Nagar College**	24-09-2022	Continuing
05	Academic MoU	**Jalangi Mahavidyalay**	28-09-2022	Continuing
06	Academic MoU	**Muzaffar Ahmed Mahavidyalaya**	29-11-2022	Continuing
07	Academic MoU	**Rani Dhanya Kumari College**	29-03-2023	Continuing
08	Academic Collaboration (Linkage)	**Jangipur college**	15th Mar,2021	Continuing
09	Academic Collaboration (Linkage)	**Berhampour girls college**	15th Mar,2021	Continuing
10	Academic Collaboration (Linkage)	**Deptt. Of mathematics University of Calcutta**	29th March,2020	Continuing
11	Academic Collaboration (Linkage)	**Barrackpore Rastraguru Surendranath college**	2nd March,2021	Continuing
12	Academic Collaboration (Linkage)	**Deptt Of Civil And Environmental Engineering, University Of Hampshire**	17th November 2022	Continuing
13	Academic Collaboration (Linkage)	**Kaliganj Government college**	May, 2022	Continuing
14	Academic Collaboration (Linkage)	**IIRS-ISRO, Dehradun, India**	29th June 2020	3rd July 2020

DR. KAMAL KRISHNA SARKA
Principal
Sripat Singh College
Jiaganj, Murshidabad

पश्चिमबङ्गा पश्चिम बंगाल WEST BENGAL

U 038845

Memorandum of understanding

Between

Sripat Singh College,Jiaganj,Murshidabad,Pin-742123,

Subhas Chandra Bose Centenary college,Lalbagh , Murshidabad,Pin-742149,

Lalgola College ,Lalgola,Murshidabad, Pin-742148,

Nabagram Amar Chand Kundu College,Nabagram,Murshidabad, Pin-742184.

This MOU is entered into on 21 May 2018, by and between Sripat Singh College,Jiaganj,Murshidabad , Subhas Chandra Bose Centenary College,Lalbagh , Murshidabad, Lalgola College ,Lalgola, Murshidabad, Pin-742148, Nabagram Amar Chand Kundu College,Nabagram,Murshidabad, Pin-742184.

The aforesaid institutions are referred to individually as institute and collectively as institutions

1. **Objectives of the MOU**
   - To promote & enhance Career oriented activities in the institutions.
   - To provide consultation for implementation of Career Development Counselling Cell in the colleges.
   - To promote skill development activities in the institutions.
   - To promote counselling service in the institutions.
   - To boost up placement activities in the institutions.
   - To promote research on Skill Development in the institutions.
   - To promote entrepreneurship among students in the institutions.

2. **Technical areas of collaboration.**
   - Provide consultation for implementation of Career Development Counselling Cell at the college.
   - Provide necessary help in organizing workshop/seminar/personality development
   - Classes at the college for enhancement of skills in respect of faculty ,staff members, students .
   - Provide industry & academic oriented interaction with the students.
   - Special lectures at the college on topic of relevance to modern industry.
   - A continuing quality development program to improve quality of students, non teaching & teaching staff through short term/long term certificate course jointly initiated by the colleges.
   - Usage of academic infrastructure at the colleges, where applicable & agreed.
   - To provide special training to final year students (UG/PG)
   - Jointly supervision of progress of the concern area.

3. Proposed mode of collaboration

Sripat Singh College, SCBC College,Lalgola College , Nabagram Amar Chand Ghosh College proposed to collaborate through the following.

   - Cooperation & promotion of Career oriented activities & training in the areas of mutual interest.
   - Any other mode of interaction agreed upon among the colleges.
   - A specific plan will be work out by the institutes depending upon availability of resources. A specific agreement will be entered into for each activity.

4. Terms & Condition

   - The cost of consultancy service (if any) should be borne by the respective college.
   - For continuing training program to respective college for Students, non teaching ,teaching staff members, the financial arrangements will be made mutually agreed terms.
   - For the visits, related to advice & consultancy, travel & other expenses of faculty & staff shall be reimbursed by the respective college on mutually agreed terms.
   - Usage of academic infrastructure at the respective college can be allowed for limited period subject to its availability, approval of head of the institution.
   - Institutions are agreed to help, identify and invite the faculty members & researchers from the other institution to participate in conference, workshop and short courses.
   - This MOU may be amended, renewed & terminated by mutual written agreement.

Confidentiality

he institutions are agreed to hold in confidence all information/data designated by the stitutions as being confidential which is obtained from each of the institution or created uring the performance of the MOU and will not disclose the same to any third party without ritten consent of the institution.

. Duration of MOU

his MOU, unless extended by mutual written consent of the institutions shall expire in five ears after the date of signing the MOU. However, on review, the MOU shall be extended for nother two years by mutual consent.

7. Coordination.

Institutions will designate person/persons who will have responsibility for coordination & implementation of this agreement. Institutions will officially inform the name of the coordinator or coordinators .

8. Intellectual property rights.

Intellectual property rights that arise as a result of joint research & collaborative activities under the agreement will be worked out on a case to case basis and will be consistent with officially laid down IPR policies of the institutions.

9. Signed in Duplicate.

This MOU is executed in duplicate with each copy being an official version and having equal legal validity by signing below, the institutions, acting by their duly authorised officers, have caused this memorandum of understanding to be executed effective as of the day and year first above written.

On behalf of Sripat Singh College

Principal
Sripat Singh College
Jiaganj, Murshidabad

Principal

Seal of the Institute

Witness - 1) 21/5/18 2) 21/5/18

On behalf of SCBC College

Teacher-in-charge
S. C. B. C. College
Lalbagh, Murshidabad

Teacher in Charge

Seal of the Institute

Witness - 1) 21/05/18 2) 21/5/18

On behalf of Lalgola College

Teacher-in-Charge
Lalgola College
Lalgola, Murshidabad

Teacher in Charge

Seal of the Institute

Witness - 1) 21/5/18 2)

On behalf of Nabagram Amar Chand Kundu College

Teacher-in-Charge
Nabagram Amarchand Kundu College
Nabagram, Murshidabad

Teacher in Charge

Seal of the Institute

Witness - 1) 21/05/18 2)

पश्चिमबङ्ग पश्चिम बंगाल WEST BENGAL AB 790532

Memorandum of Understanding

Between

Sripat Singh College, P.O+P.S: Jiaganj, Dist: Murshidabad, Pin-742123

&

Jalangi Mahavidyalaya P.O.- Jalangi Dist - Murshidabad Pin - 742305

This agreement is entered into on 28 September, 2022 by and between **Sripat Singh College,P.O+P.S:Jiaganj,Dist:Murshidabad,Pin-742123** and **Jalangi Mahavidyalaya,P.O.-Jalangi Dist : Murshidabad,Pin - 742305**

The aforesaid institutions are referred to individually as institute and collectively as institutions.

SRIPAT SINGH COLLEGE ★ MSD. ★ JIAGANJ ★ Estd. 1949

Jalangi Mahavidyalaya ★ Estd -2010 ★ Jalangi, Murshidabad

1. **Objectives of the MOU**
   - To promote & enhance career oriented activities in the institutions
   - To provide consultation for implementation of Career Development Counseling & Placement Cell in the colleges.
   - To promote Skill development activities in the institutions.
   - To promote Counseling service in the institutions.
   - To boost up placement activities in the institutions.
   - To promote research on Skill development in the institutions
   - To promote entrepreneurship among students.
2. **Technical areas of collaboration.**
   - Provide consultation for implementation of Career Development Counseling and Placement Cell at the college.
   - Provide necessary help in organizing workshop/seminar/personality development activities.
   - Classes at the college for enhancement of skills in respect of faculty, staff members, students.
   - Provide industry & academic oriented interaction with the students.
   - Special lectures at the college on topic of relevance to modern industry.
   - A continuing quality development program to improve quality of students, non teaching & teaching staff through short term/long term certificate course jointly initiated by the colleges.
   - Usage of academic infrastructure at the colleges, where applicable & agreed.
   - To provide special training to final year students (UG/PG)
   - Joint supervision of progress of the concern area.
3. **Proposed mode of collaboration**

   Sripat Singh College and **Jalangi Mahavidyalaya** proposed to collaborate through the following.
   - Cooperation & promotion of Career oriented activities & training in the areas of mutual interest.
   - Any other mode of interaction agreed upon among the colleges.
   - A specific plan will be work out by the institutes depending upon availability of resources. A specific agreement will be entered into for each activity.
4. **Terms & Condition**
   - The cost of consultancy service (if any) should be borne by the respective college.

SRIPAT SINGH COLLEGE ★ JIAGANJ, MSD. ★ Estd. 1949

Jalangi Mahavidyalaya ★ Estd -2010 ★ Jalangi, Murshidabad

- For continuing training program to respective college for Students, non teaching, teaching staff members, the financial arrangements will be made mutually agreed terms.
- For the visits, related to advice & consultancy, travel & other expenses of faculty & staff shall be reimbursed by the respective college on mutually agreed terms.
- Usage of academic infrastructure at the respective college can be allowed for limited period subject to its availability, approval of head of the institution.
- Institutions are agreed to help, identify and invite the faculty members & researchers from the other institution to participate in conference, workshop and for short courses.
- This **MOU** may be amended, renewed & terminated by mutual written agreement.

5. **Confidentiality**

The institutions are agreed to hold in confidence all information/data designated by the institutions as being confidential which is obtained from each of the institution or created during the performance of the MOU and will not disclose the same to any third party without written consent of the institution.

6. **Duration of MOU**

This MOU, unless extended by mutual written consent of the institutions shall expire in five years after the date of signing the MOU. However, on review, the MOU may be extended for another five years by mutual consent.

7. **Coordination**

Institutions will designate person/persons who will have responsibility for coordination & implementation of this agreement. Institutions will officially inform the name of the coordinator or coordinators.

8. **Intellectual property rights**

Intellectual property rights that arise as a result of joint research & collaborative activities under the agreement will be worked out on a case to case basis and will be consistent with officially laid down IPR policies of the institutions.

9. **Signed in Duplicate.**

This **MOU** is executed in duplicate with each copy being an official version and having equal legal validity by signing below, the institutions, acting by their duly authorized officers, have caused this memorandum of understanding to be executed effective as of the day and year first above written.

SRIPAT SINGH COLLEGE ★ JIAGANJ, MSD. ★ Estd. 1949

Jalangi Mahavidyalaya ★ Estd -2010 ★ Jalangi, Murshidabad

On behalf of **Sripat Singh College** Seal of the Institution

- Teacher in Charge : Asis Kumar Sen
  Teacher-in-Charge
  Sripat Singh College
  Jiaganj, Murshidabad
  28/09/2022
- Coordinator,IQAC :
  Sumit Bandyopadhyay 28.09.2022
  IQAC
  Co-ordinator
  Sripat Singh College
  Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD 1949 JIAGANJ, MSD.

Witness: 1) Abhishek Basu 28/09/22 **2)** Shyam Sundar Sen

On behalf of **Jalangi Mahavidyalaya** Seal of the Institution

- Teacher in Charge : T.I.C
  Jalangi Mahavidyalaya
  Jalangi, Murshidabad
  28.9.22
- Coordinator,IQAC : Nilakshi Bagchi
  IQAC Coordinator 28.9.22
  Jalangi Mahavidyalaya

Jalangi Mahavidyalaya Estd -2010 Jalangi, Murshidabad

Witness: 1) **2)**

SRIPAT SINGH COLLEGE Estd 1949 JIAGANJ, MSD.

Jalangi Mahavidyalaya Estd -2010 Jalangi, Murshidabad

पश्चिम बङ्গ पश्चिम बंगाल WEST BENGAL AB 790531

Memorandum of Understanding

Between

Sripat Singh College,P.O+P.S:Jiaganj,Dist:Murshidabad,Pin-742123

&

Nagar College,PO:Nagar,P.S:Khargram,Dist:Murshidabad,Pin-742159

This agreement is entered into on 24 September, 2022 by and between **Sripat Singh College**,P.O+P.S:Jiaganj,Dist:Murshidabad,Pin-742123 and **Nagar College** , P.O: Nagar,P.S:Khargram,Dist:Murshidabad,Pin-742159.

The aforesaid institutions are referred to individually as institute and collectively as institutions.

1. **Objectives of the MOU**
   - To promote & enhance career oriented activities in the institutions
   - To provide consultation for implementation of Career Development Counselling & Placement Cell in the colleges.
   - To promote Skill development activities in the institutions.
   - To promote Counselling service in the institutions.
   - To boost up placement activities in the institutions.
   - To promote research on Skill development in the institutions
   - To promote entrepreneurship among students.
2. **Technical areas of collaboration.**
   - Provide consultation for implementation of Career Development Counselling and Placement Cell at the college.
   - Provide necessary help in organizing workshop/seminar/personality development activities.
   - Classes at the college for enhancement of skills in respect of faculty, staff members, students.
   - Provide industry & academic oriented interaction with the students.
   - Special lectures at the college on topic of relevance to modern industry.
   - A continuing quality development program to improve quality of students, non teaching & teaching staff through short term/long term certificate course jointly initiated by the colleges.
   - Usage of academic infrastructure at the colleges, where applicable & agreed.
   - To provide special training to final year students (UG/PG)
   - Joint supervision of progress of the concern area.
3. **Proposed mode of collaboration**

   Sripat Singh College and **Nagar College** proposed to collaborate through the following.
   - Cooperation & promotion of Career oriented activities & training in the areas of mutual interest.
   - Any other mode of interaction agreed upon among the colleges.
   - A specific plan will be work out by the institutes depending upon availability of resources. A specific agreement will be entered into for each activity.
4. **Terms & Condition**
   - The cost of consultancy service (if any) should be borne by the respective college.
   - For continuing training program to respective college for Students, non teaching, teaching staff members, the financial arrangements will be made mutually agreed terms.
   - For the visits, related to advice & consultancy, travel & other expenses of faculty & staff shall be reimbursed by the respective college on mutually agreed terms.

- Usage of academic infrastructure at the respective college can be allowed for limited period subject to its availability, approval of head of the institution.
- Institutions are agreed to help, identify and invite the faculty members & researchers from the other institution to participate in conference, workshop and for short courses.
- This **MOU** may be amended, renewed & terminated by mutual written agreement.

5. **Confidentiality**

The institutions are agreed to hold in confidence all information/data designated by the institutions as being confidential which is obtained from each of the institution or created during the performance of the MOU and will not disclose the same to any third party without written consent of the institution.

6. **Duration of MOU**

This MOU, unless extended by mutual written consent of the institutions shall expire in five years after the date of signing the MOU. However, on review, the MOU may be extended for another five years by mutual consent.

7. **Coordination**

Institutions will designate person/persons who will have responsibility for coordination & implementation of this agreement. Institutions will officially inform the name of the coordinator or coordinators.

8. **Intellectual property rights**

Intellectual property rights that arise as a result of joint research & collaborative activities under the agreement will be worked out on a case to case basis and will be consistent with officially laid down IPR policies of the institutions.

9. **Signed in Duplicate.**

This **MOU** is executed in duplicate with each copy being an official version and having equal legal validity by signing below, the institutions, acting by their duly authorised officers, have caused this memorandum of understanding to be executed effective as of the day and year first above written.

On behalf of **Sripat Singh College** Seal of the Institution

Teacher-in-Charge
Sripat Singh College
Jiaganj, Murshidabad

IQAC
Co-ordinator
Sripat Singh College
Jiaganj, Murshidabad

1. Teacher in Charge : Atis Kumar Sen 24/09/2022
2. Coordinator,IQAC : Sumit Bandyopadhyay

Witness: 1) Sharmila Datta Banik 24.09.22 **2)** Shyan Sripat Singh College

On behalf of **Nagar College** Seal of the Institution

1. Teacher in Charge : Sudipta Sau 24/09/22
2. Coordinator,IQAC : Ananya Sarkar 24/09/2022

Teacher-in-Charge
Nagar College
Nagar, Murshidabad

Coordinator
I.Q.A.C
Nagar College
Nagar, Murshidabad

Witness: 1) Abhishek Basu. **2)** Bishwajit Mondal

पश्चिमबङ्गा पश्चिम बंगाल WEST BENGAL AL 776501

Sripat Singh College, P.O+P.S: Jiaganj, Dist: Murshidabad, Pin-742123

&

Rani Dhanya Kumari CollegeP.O+P.S: Jiaganj, Dist: Murshidabad, Pin-742123

This agreement is entered into on **29 March, 2023** by and between **Sripat Singh College**,P.O+P.S:Jiaganj,Dist:Murshidabad,Pin-742123 and **Rani Dhanya Kumari College** PO+P.S: Jiaganj, Dist: Murshidabad, Pin-742123.

The aforesaid institutions are referred to individually as institute and collectively as institutions.

1. Objectives of the MOU

➢ To promote & enhance career oriented activities in the institutions.

➢To provide consultation for implementation of Career Development Counseling & Placement Cell in the colleges.

➢ To promote **Skill development** activities in the institutions.

➢ To promote **Counseling service** in the institutions.

➢To boost up **placement activities** in the institutions.

➢ To promote **research on Skill development** in the institutions.

➢To promote **entrepreneurship** among students.

2. Technical areas of collaboration.

➢ Provide consultation for implementation of Career Development Counseling and Placement Cell at the college.

➢ Provide necessary help in organizing workshop/seminar/personality development activities & Soft skill training.

➢Classes at the college for enhancement of skills in respect of faculty, staff members, students.

➢ Provide Industry & Academia interaction with the students.

➢ Special lectures at the college on the topic of relevance to modern industry.

➢ A continuing quality development program to improve quality of students, non teaching & teaching staff through short term/long term certificate courses jointly initiated by the colleges.

➢ Usage of academic infrastructure at the colleges, where applicable & agreed.

➢ To provide special training to final year students (UG/PG)

SRIPAT SINGH COLLEGE ★ Murshidabad ★ EST 1949 PIN-742 123 (W.B.)

R.D.M. COLLEGE ★ Jiaganj, Murshidabad ★ Estd 1962

➢Joint supervision of progress of the concerned area.

3. Proposed mode of collaboration

Sripat Singh College and **Rani Dhanya Kumari College** proposed to collaborate through the following.

➢ Cooperation & promotion of Career oriented activities & training in the areas of mutual interest.

➢ Any other mode of interaction agreed upon among the colleges.

➢A specific plan will be worked out by the institutes depending upon availability of resources. A specific agreement will be entered into for each activity.

4. Terms & Condition

➢The cost of consultancy service (if any) should be borne by the respective college.

➢For continuing training programs to respective colleges for Students, non teaching, teaching staff members, the financial arrangements will be made mutually agreed terms.

➢ For the visits, related to advice & consultancy, travel & other expenses of faculty
& staff shall be reimbursed by the respective college on mutually agreed terms.

➢Usage of academic infrastructure at the respective college can be allowed for a limited period subject to its availability, approval of the head of the institution.

➢Institutions are agreed to help, identify and invite the faculty members & researchers from the other institution to participate in conferences, workshops and for short courses.

SRIPAT SINGH COLLEGE * Jiaganj, Murshidabad * EST.-1949 PIN-742123 (W.B.)

R.D.K. COLLEGE * Jiaganj, Murshidabad * Estd 1962

➢ The **MOU** may be amended, renewed & terminated by mutual written agreement.

5. Confidentiality

The institutions are agreed to hold in confidence all information/data designated by the institutions as being confidential which is obtained from each of the institutions or created during the performance of the **MOU** and will not disclose the same to any third party without written consent of the institution.

6. Duration of MOU

This MOU, unless extended by mutual written consent of the institutions, shall expire in ten years after the date of signing the **MOU**. However, on review, the **MOU** may be extended for another ten years by mutual consent.

7. Coordination

Institutions will designate a person/persons who will have responsibility for coordination & implementation of this agreement. Institutions will officially inform the name of the coordinator or coordinators.

8. Intellectual property rights

Intellectual property rights that arise as a result of joint research & collaborative activities under the agreement will be worked out on a case to case basis and will be consistent with officially laid down IPR policies of the institutions.

9. Signed in Duplicate

This **MOU** is executed in duplicate with each copy being an official version and having equal legal validity by signing below, the institutions, acting by their duly authorised officers, have caused this memorandum of understanding to be executed effective as of the day and year first above written.

SRIPAT SINGH COLLEGE ★ Jiaganj, Murshidabad ★ EST. 1949 PIN-742 223 (W.B.)

R.D.K. COLLEGE ★ Jiaganj, Murshidabad ★ Estd 1962

On behalf of Sripat Singh College

College Seal

1. Teacher in Charge/Principal :
   (Asis Kumar Sen)
2. Teachers Council Secretary :
   (SHARMILA DATTA BANIK)

Witness:

1)

2)

Bursar
Sripat Singh College
Jiaganj, Murshidabad

On behalf of Rani Dhanya Kumari College

College Seal

1. Teacher in Charge/Principal:
   29/3/23.
   Dr. Ajoy Adhikari
   Principal
   R.D.K. College
   Jiaganj, Murshidabad
2. . Coordinator, IQAC : NAAC
   29/03/23.
   (Dr. Mousumi Chakraborty).

Witness:

1) Dr. Syamal Kumar Mandal
   29.3.23
   BURSAR
   R. D. K. College
   Jiaganj Murshidabad

2) SUBHAJIT DAS
   29/03/23

Memorandum of Understanding

This Memorandum of Understanding (hereinafter called the MOU) is signed on the 15th day of March, 2021 between Dr. Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Keshab Chandra Ghosh, Assistant Professor of History, Jangipur College, Jangipur, Murshidabad, regarding research collaborations on two edited books: "Revisiting The History of India & Beyond" and "Colonial Origins of Modernity in India: Society, Polity, and Culture."

Clauses of MoU

1. Both signing parties will adhere to research ethics, share ideas, and avoid any conflict of interest while publishing any documents or research articles.
2. Both parties will utilize research grants from any source for the fulfillment of the project.

Time Period of Collaboration

This collaboration will remain in effect until one of the signing parties wishes to withdraw from the MOU.

Signed

First Party: Sagar Simlandy

Second Party: Keshab Chandra Ghosh

Functionality of the MOU

Within the purview of the MOU signed between Dr. Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Keshab Chandra Ghosh, Assistant Professor of History, Jangipur College, Jangipur, Murshidabad, the following outcomes were obtained:

- Edited book, "Revisiting The History of India & Beyond," published by Online Gatha - The Endless Tale, Lucknow, in June 2021, ISBN 978-93-90388-94-3.
- Edited book, "Colonial Origins of Modernity in India: Society, Polity, and Culture," published by BFC Publications, Lucknow, in August 2022, ISBN 978-93-5632-427-5.

Signed: Dated the 15th March 2021

First Party: Sagar Simlandy

Second Party: Keshab Chandra Ghosh

Signature of Principal with Seal

Sripat Singh College: _____

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE * JIAGANJ * ESTD-1949

Jangipur College: _____

Memorandum of Understanding

This Memorandum of Understanding (hereinafter called the MOU) is signed on the 15th day of March, 2021 between Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Ganesh Kr. Mandal, Assistant Professor of History, Berhampore Girl's College, Berhampore, Murshidabad, regarding research collaborations in two edited books on "Taking another look at the History of India & Abroad".

Clauses of MoU

1. Both signing parties will adhere to research ethics, share ideas, and avoid any conflict of interest while publishing any documents or research articles.
2. Both parties will utilize research grants from any source for the fulfillment of the project.

Time Period of Collaboration

This collaboration will remain in effect until one of the signing parties wishes to withdraw from the MOU.

Signed

First Party: Sagar Simlandy

Second Party: Ganesh Kr. Mandal

Functionality of the MOU

Within the purview of the MOU signed between Mr. Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Ganesh Kr. Mandal, Assistant Professor of History, Berhampore Girl's College, Berhampore, Murshidabad, the following outcomes were obtained:

- Edited book, "Taking another look at the History of India & Abroad," published by BFC Publication, Lucknow, in August 2021, ISBN 978-93-90880-12-6.

Signed: Dated the 15th April, 2021

First Party: Sagar Simlandy

Second Party: Ganesh Kr. Mandal

Signature of Principal with Seal

Sripat Singh College: _____

Berhampore Girl's College: _____

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

Clauses of MoU

1. Research Collaboration: Both parties agree to collaborate on research related to the isolation and characterization of Microbacterium paraoxydansfor bioremediation and plant growth promotion.
2. Research Ethics: Both parties will adhere to strict research ethics, share ideas, and avoid any conflict of interest while publishing documents or research articles.
3. Resource Utilization: Both parties will utilize research grants from any source for the fulfillment of the project.

Time Period of Collaboration

This MoU will remain in effect until one of the signing parties wishes to withdraw from the agreement.

Signed:

First Party: Abhishek Basu, Sanjit Mandal

Second Party: Chatterjee

SRIPAT SINGH COLLEGE ESTD-1949

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Memorandum of Understanding

This Memorandum of Understanding (here in after called the MOU) is signed on the 21 Day of March, 2020 between Mr. Sudhanshu Kumar Biswas, Assistant Professor, Dept. of Mathematics, Sripat Shing College, Jiaganj, Murshidabad and Dr. Uttam Ghosh, Assistant Professor, Department of Applied Mathematics, University of Calcutta, 92 APC Road, Kolkata700009 about Research Collaborations in four published research articles on Mathematical disease modelling.

Clauses of MOU

1) Both the signing parties will follow Research ethics. share ideas and will not show any conflict of interest while publishing any documents or research articles.
2) Both the parties will utilise Research Grants whatsoever from any source for the fulfilment of that project.

Time period of Collaboration
This collaborating MOU will remain in vogue until one of the signing parties wishes to withdraw himself from the MOU

Signed

1. First Party

Sudhanshu Kumar Biswas.

2. Second Party

University of Kalyani, Kalyani.

Sub: Request for Approval in University Listed Book

Respected Sir,

We have edited a book entitled "History of Education in India" (ISBN-978-93-92203-04-6) by Sagar Simlandy & Rakibul Islam, Department of History, Sripat Singh College, Jiaganj & Govt. General Degree College at Kaliganj, Nadia, published by Scriptor Publication, Uttar Pradesh, India, in the month of May, 2022. We will be highly obliged if you will approve the book as a University Listed Book.

Thanks & regards

Sagar Simlandy

Sagar Simlandy

Editor & Assistant Professor,

Department of History,

Sripat Singh College, Jiaganj

Rakibul Islam.

Rakibul Islam

Editor & Assistant Professor

Department of History,

Govt. General Degree College at Kaliganj

Received a copy

25/05/2023

Head
Department of History
University of Kalyani

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Kalyani
741235
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SRIPAT SINGH COLLEGE

Estd. 1949. Govt. Sponsored)
P.O. Jiaganj • Dist. Murshidabad • West Bengal-742123
Phone: (03483) 255351, Tele, Fax: (03483) 256961
E-mail sscollege2009@gmail.com *Web: www.sripatsinghcollege.org*

Ref. No: ...Misc, 96, 2020.....
Date: ...05/06/2020.....

To,
The Director
IIRS, ISRO, Dehradun

Sub: Willingness for participating in IIRS Outreach Programmes-reg.

Dear Sir,

Sripat Singh College, the first Govt. Sponsored co-educational degree college in West Bengal, started its journey from 1949 housed in the 'Cutcheri Bari' of great Maharaja Sripat Singh Doogar. Now, this institution receives and enriches teeming youth, catering to the socio-economic-educational-cultural needs of the regions of Murshidabad and its vicinity with its utmost sincerity and efficiency. It has now become an ideal centre of learning, education, research and humanity to shape the Nation. At present the Honours courses in almost all subjects of science and humanities group including Biotechnology and Environmental Science, regular MA course in Bengali, different UG and PG courses under Kalyani University, Nadia.

Contact Details of the focal person/ coordinator:

Name:	**Mr. SAKTI MANDAL**
Designation:	**ASSISTANT PROFESSOR**
Department:	**GEOGRAPHY**
Postal Address:	**69, R.N. TAGORE ROAD, LALDIGHI PLAZA, FLAT NO- C3 5TH FOOR, PIN- 742101, BERHAMPORE, MURSHIDABAD**
Email: (mandatory)	tomblo.sakti@gmail.com
Mobile Number: (mandatory)	**9804302153**

Principal
Sripat Singh College
Jiaganj, Murshidabad

(Signature of Authority)

Memorandum of Understanding

Between

Monojit Roy
Barrackpore Rastraguru Surendranath College
And
Amit Kumar Kundu
Sripat Singh College

Subject: Assessment of Drinking Water Quality of Different Municipal Supply Water of North 24 Parganas, West Bengal, India: A Comparative Study

---

Abstract

Clean and safe water is essential and significant for our daily life. With the unprecedented increase in population and the development of industrialization, the quality of municipal supplied water is being gradually endangered. Municipal supplied water plays a major role in drinking purposes in many urban areas of West Bengal, India. In this present study, the quality of the municipal drinking water samples of fourteen municipal areas within the North 24 Parganas district of West Bengal have been assessed. We have measured pH, TDS (Total Dissolved Solids), salinity, conductance, sodium ion concentration, potassium ion concentration, and pesticide residue concentration. Investigated water samples showed moderate salinity values and low to high ranges of conductance values. We have also encountered high sodium ion content in three municipality supply waters, whereas we got moderately low concentrations of potassium ion in these drinking water samples. Several water samples showed relatively high pH, another showed a very high TDS value, while eight municipal supply waters showed moderate TDS values. During the study of seventeen pesticide residues in these municipal drinking water samples, no sample water contained pesticide concentration higher than the BIS (Bureau of Indian Standards) limit.

SRIPAT SINGH COLLEGE 1949 JIAGANJ, MSD

DR. KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Memorandum of Understanding

1. Purpose
The purpose of this Memorandum of Understanding (MoU) is to establish the terms and conditions under which Monojit Roy of Barrackpore Rastraguru Surendranath College and Amit Kumar Kundu of Sripat Singh College will collaborate on the assessment of the drinking water quality of different municipal supply waters in North 24 Parganas, West Bengal, India.

2. Scope of Work
- The study will involve the collection and analysis of water samples from fourteen municipal areas within North 24 Parganas.
- The parameters to be measured include pH, TDS, salinity, conductance, sodium ion concentration, potassium ion concentration, and pesticide residue concentration.
- Both parties will jointly conduct the analysis, share data, and prepare the final report.

3. Roles and Responsibilities
- Monojit Roy: Responsible for overseeing the collection of water samples and conducting the analysis of pH, TDS, and salinity.
- Amit Kumar Kundu: Responsible for analyzing conductance, sodium ion concentration, potassium ion concentration, and pesticide residue concentration.

4. Collaboration and Data Sharing
- Both parties agree to share all data and findings related to the study.
- The data will be used solely for the purpose of the study and publication in academic journals.
- Any publication or presentation of the findings will be jointly authored by both parties.

5. Duration
This MoU will remain in effect from the date of signing until the completion of the study and publication of the results.

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DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

6. Financial Implications
- Each party will bear their own costs incurred in the course of the study.
- Any external funding or grants secured for the project will be shared as per mutual agreement.

7. Confidentiality
Both parties agree to maintain the confidentiality of any proprietary or sensitive information exchanged during the course of the study.

8. Termination
This MoU can be terminated by either party with a written notice of 30 days.

9. Dispute Resolution
Any disputes arising from this MoU will be resolved through mutual discussion and negotiation.

Dr. Monojit Ray

Signatures-

Monojit Roy
Barrackpore Rastraguru Surendranath College
Date: _____

Amit Kumar Kundu
Sripat Singh College
Date: 18/02/21

Principal
Barrackpore Rastraguru
Surendranath College

Principal
Sripat Singh College

SRIPAT SINGH COLLEGE ESTD- JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Barrackpore Rastraguru Surendranath College

Date 02/03/21

To Whom It May Concern

This is to certify that the college has no objection if Prof Dr Mr Ms **Monojit Ray** will undergo collaborative research with **Department of Chemistry, Sripat Sing College** for 12 months with effect from **02.03.2021**

Deb Roychowdhury

Sri Deb Roychoudhury

Principal, Barrackpore Rastraguru Surendranath College

Criterion 3 - Research, Innovations and Extension

3.5: Collaboration

3.5.1 Number of functional MoUs/linkages with institutions/ industries in India and abroad for internship, on-the-job training, project work, student / faculty exchange and collaborative research during the last five years.

LIST OF DOCUMENTS

List of year wise activities and exchange should be provided

Sripat Singh College

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Sripat Singh College

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www.sripatsinghcollege.edu.in E-mail: sscollege2009@gmail.com

List of activities under Linkage and MoU

Sl. No.	***Year***	***Name of the collaborating institution with whom the MoU / collaboration / linkage is made***	***Nature of collaboration Activity***
01	2018-2023	**Nabagram Amar Chand Kundu College, Nabagram Murshidabad**	✸ To promote & enhance Career oriented activities in the institutions. ✸ Inter college Webinar. ✸ To provide consultation for implementation of Career Development Counseling Cell in the colleges. ✸ To promote skill development activities in the institutions. ✸ To promote counseling service in the institutions. ✸ To boost up placement activities in the institutions. ✸ To promote research on Skill Development in the institutions.
02	2018-2023	**Subhas Chandra Bose Centenary College, Lalbagh, Murshidabad**	✸ To promote & enhance Career oriented activities in the institutions. ✸ Inter college Webinar. ✸ Exchange of students, Enterpreneurial skill development, Outcome based training and placement. ✸ To provide consultation for implementation of Career Development Counseling Cell in the colleges. ✸ To promote skill development activities in the institutions. ✸ To promote counseling service in the institutions. ✸ To boost up placement activities in the institutions. ✸ To promote research on Skill Development in the institutions.
03	2018-2023	**Lalgola College, Lalgola, Murshidabad**	✸ Improving advancement of Learning and Need-based Education. ✸ Inter college Webinar. ✸ Exchange of students, Enterpreneurial skill development, Outcome based training and placement. ✸ To provide consultation for implementation of Career Development Counseling Cell in the colleges. ✸ To promote skill development activities in the institutions.

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Sl. No.	*Year*	*Name of the collaborating institution with whom the MoU / collaboration / linkage is made*	*Nature of collaboration Activity*
04	2022-2023	**Nagar College, Nagar Murshidabad**	✹ Teachinq-leanring and other academic activities. ✹ Inter college Webinar. ✹ Improving advancement of Learning and Need-based Education. ✹ To promote & enhance Career oriented activities in the institutions. ✹ Exchange of students, Enterpreneurial skill development, Outcome based training and placement. ✹ To provide consultation for implementation of Career Development Counseling Cell in the colleges.
05	2022-2023	**Jalangi Mahavidyalay, Jalangi, Murshidabad**	✹ To promote & enhance Career oriented activities in the institutions. ✹ Exchange of students, Enterpreneurial skill development, Outcome based training and placement. ✹ To provide consultation for implementation of Career Development Counseling Cell in the colleges. ✹ To promote skill development activities in the institutions. ✹ To promote counseling service in the institutions. ✹ Inter college Webinar. ✹ To boost up placement activities in the institutions. ✹ To promote research on Skill Development in the institutions.
06	2022-2023	**Muzaffar Ahmed Mahavidyalaya P.O.- Salar, Block- Bharatpur -II (Salar), Sub-Div- Kandi, Dist:- Murshidabad, West Bengal, Pin- 742401.**	✹ Inter college Webinar. ✹ To promote & enhance Career oriented activities in the institutions. ✹ To provide consultation for implementation of Career Development Counseling Cell in the colleges. ✹ To promote skill development activities in the institutions. ✹ To promote counseling service in the institutions. ✹ To boost up placement activities in the institutions. ✹ To promote research on Skill Development in the institutions.

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Sl. No.	*Year*	*Name of the collaborating institution with whom the MoU / collaboration / linkage is made*	*Nature of collaboration Activity*
07	2023-2024	**Rani Dhanya Kumari College, Jiaganj Murshidabad 742123**	✸ Inter college Webinar. ✸ Student and faculty exchange program ✸ To promote & enhance Career oriented activities in the institutions. ✸ To provide consultation for implementation of Career Development Counseling Cell in the colleges. ✸ To promote skill development activities in the institutions. ✸ To promote counseling service in the institutions. ✸ To boost up placement activities in the institutions. ✸ To promote research on Skill Development in the institutions.
08	2022	**Jangipur College, Jangipur, Murshidabad, West Bengal, India**	✸ Edited Book Published
09	2022	**Berhampore Girls' College, Berhampore Murshidabad**	✸ Edited Book Published
10	2020	**Deptt. Of mathematics University of Calcutta**	✸ Collaborative Research Work (Mathematics)
11	2021	**Barrackpore Rastraguru Surendranath College**	✸ Collaborative Research Work (Chemistry)
12	2022	**Deptt Of Civil And Environmental Engineering, University Of Hampshire**	✸ Collaborative Research Work
13	2022	**Kaliganj Government College, Kaliganj, Nadia**	✸ Edited Book Published
14	2020-2023	**IIRS-ISRO, Dehradun, India**	✸ Collaborative online course on “Satellite photogrammetry and its Application”

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Some Picture of Academic linkage and MoUs Activity

Pic. 1 MoU Signe With Rani Dhanya Kumari College

Pic. 2 MoU Signe With Jalangi Mahavidyalaya

Pic. 3 MoU Signe With Muzaffar Ahmed Mahavidyalaya

Pic. 4 MoU Signe With Nagar College

Pic. 5 MoU Signe with Subhas Chandra Bose Centenary College

Pic. 6 MoU Signe with Lalgola College

Pic. 7 MoU signe With Nabagram Amar Chand Kundu College

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Some Picture of Academic linkage and MoUs Activity

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Principal
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Jiaganj, Murshidabad

Report on MOU for the Session 2018-19

Colleges under MOU: Nabagram Amar Chand Kundu College, Nabagram, Murshidabad

and

Sripat Singh College, Jiaganj, Murshidabad

1. **Date of Execution of MOU:** **21/05/2018**
2. **Tenure of the MOU:** **5 years**
3. **Purpose/ Objectives of MOU-**
   - **To promote academic excellence and innovation in education;**
   - **To facilitate the sharing of academic resources between the two institutions;**
   - **To share information and expertise in areas of mutual interest**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
14/03/2019	Collaborative Seminar	CINI (Child -in-Need Institute)	One-day seminar on preventive measures against women trafficking	50

Soumitra Kar

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15.6.24

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SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

OUTCOME:

- **The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.**
- **The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.**
- **The practice of academic exchange has proved to be very helpful in developing a healthy mutual relationship leading to the holistic development of both institutions.**

Soumitra Kar

.....

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13.6.24

.....

Dr. Kamal Krishna Sarkar
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Report on MOU for the Session 2019-20

Colleges under MOU: Nabagram Amar Chand Kundu College, Nabagram, Murshidabad

and

Sripat Singh College, Jiaganj, Murshidabad

1. **Date of Execution of MOU:** **21/05/2018**
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4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
22/02/2020	Special Class	MR. Abhijit Bhattacharyya (English) Nabagram Amar Chand Kundu College	Partition Literature	40
24/02/2020	Special Class	Dr. Sagar Simlandy (History) Sripat Singh College	Recent Trends in Historiography	28

Soumitra Kar

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DR. KAMAL KRISHNA SARKAR
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OUTCOME:

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Report on MOU for the Session 2020-21

Colleges under MOU: Nabagram Amar Chand Kundu College, Nabagram, Murshidabad

and

Sripat Singh College, Jiaganj, Murshidabad

1. **Date of Execution of MOU:** **21/05/2018**
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   - **To share information and expertise in areas of mutual interest**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
19-05-2021	Joint Career Counselling	Mr. Shayam Sundar Seth (SSC) Mr. Abhijit Bhattacharyya (NACKC)	Career Orientation Programme
31-05-2021	Joint Career Counselling	Mr. Shayam Sundar Seth (SSC) Mr. Abhijit Bhattacharyya (NACKC)	Career Orientation Programme
18-06-2021	Joint Webinar (4 Colleges)	Dr. Rathindranath Baral, Chittaranjan National Cancer Institute	Webinar on COVID-19 second wave and the importance of vaccination

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SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

Report on MOU for the Session 2021-22

Colleges under MOU: Nabagram Amar Chand Kundu College, Nabagram, Murshidabad

and

Sripat Singh College, Jiaganj, Murshidabad

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3. **Purpose/ Objectives of MOU-**
   - **To promote academic excellence and innovation in education;**
   - **To facilitate the sharing of academic resources between the two institutions;**
   - **To share information and expertise in areas of mutual interest**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
23/02/2022	Special Class	Swapan Kumar Sarkar (History) Sripat Singh College	European Imperialism	30
21/05/2022 & 28/05/2022	Inter-College Students Program	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College	PowerPoint presentation competition	30

Soumitra Kar

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OUTCOME:

- **The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.**
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- **The practice of academic exchange has proved to be very helpful in developing a healthy mutual relationship leading to the holistic development of both institutions.**

Soumitra Kar

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Dr. Kamal Krishna Sarkar
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Jiaganj, Murshidabad, West Bengal, India

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

Report on MOU for the Session 2022-23

Colleges under MOU: Nabagram Amar Chand Kundu College, Nabagram, Murshidabad

and

Sripat Singh College, Jiaganj, Murshidabad

1. **Date of Execution of MOU:** **21/05/2018**
2. **Tenure of the MOU:** **5 years**
3. **Purpose/ Objectives of MOU-**
   - **To promote academic excellence and innovation in education.**
   - **To facilitate the sharing of academic resources between the two institutions.**
   - **To collaborate in the development of new educational programs and initiatives in accordance with the directives of NEP 2020.**
   - **To share information and expertise in areas of mutual interest.**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
03/07/2022	Inter-College Webinar	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College	Webinar on plastic pollution: myth vs reality
20/07/2022	Campus Drive	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College	Campus Drive
12/08/2022	Inter College Student Competition	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College	Poster competition on Azadi-Ki Amrit Mahotsav

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27/08/2022	Inter-College Webinar	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College	Webinar for WBCS Examination Preparation
28/12/2022	Inter-College Webinar	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College (v) Jalangi Mahavidalaya (vi) Nagar College	Webinar on the importance of the Entrepreneurial mindset of the students for future livelihood
30/12/2022	Inter-College Webinar	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College (v) Jalangi Mahavidalaya (vi) Nagar College	Webinar on the Importance of financial literacy
15/03/2023	Inter-College Webinar	Pantaloons (Aditya Birla Fashion and Retail Ltd)	Webinar on scope and future in Retail Sector
26/04/2023	Inter-College Webinar	GEM- JEWELLERY Council of India	Webinar on scope and future in GEM- and Jewellery Sector
18/05/2023	Inter-College Webinar	Mahindra Classroom	One-day webinar on importance of soft skills for women's empowerment
7/06/2023	Inter-College Webinar	Skill Council for Green Jobs	One-day webinar on scope and future in green jobs
28/06/2023	Inter-College Webinar	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College (v) Jalangi Mahavidalaya (vi) Nagar College (vii) Rani Dhanya Kumari College	Webinar on breaking barriers: Empowering Women in Entrepreneurship

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OUTCOME:

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- **The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.**
- **The practice of academic exchange has proved to be very helpful in developing a healthy mutual relationship leading to the holistic development of both institutions.**

Soumitra Kar

.....

(Dr. Soumitra Kar)
Principal
Nabagram Amar Chand Kundu College
Nabagram, Murshidabad, West Bengal, India

DR. SOUMITRA KAR, (Ph. D)
Principal
Nabagram, Amar Chand Kundu College
P.O.-Nabagram, Dist.-Murshidabad
West Bengal, Pin-742184

15.6.24

.....

Dr. Kamal Krishna Sarkar
Principal
Sripat Singh College
Jiaganj, Murshidabad, West Bengal, India

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE
ESTD-1949
JIAGANJ, MSD.

Report on MOU for the Session 2023-24

Colleges under MOU: Nabagram Amar Chand Kundu College, Nabagram, Murshidabad

and

Sripat Singh College, Jiaganj, Murshidabad

1. **Date of Execution of MOU:** **21/05/2018 & 05/10/2023**
2. **Tenure of the MOU:** **5 years**
3. **Purpose/ Objectives of MOU-**
   - **To promote academic excellence and innovation in education.**
   - **To facilitate the sharing of academic resources between the two institutions.**
   - **To collaborate in the development of new educational programs and initiatives in accordance with the directives of NEP 2020.**
   - **To share information and expertise in areas of mutual interest.**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
04/01/2024	Special Lecture	Debjani Mondal (Molecular Biology & Biotechnology) Sripat Singh College	Environmental Pollution & Global Issues
04/01/2024	Special Lecture	Dr. Abhishek Basu (Molecular Biology & Biotechnology) Sripat Singh College	Recent trends in Biotechnology
04/01/2024	Student Exchange Program	(i) Nabagram Amar Chand Kundu College (ii) Netaji Nagar College (iii) Sagardighi Kamada Kinkar Smriti Mahavidyalaya (iv) Lalgola College (v) Sripat Singh College (vi) Nagar College	State-Level Inter-College Debate Competition

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SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

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DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

03/04/2024	Joint Seminar	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Sagardighi Kamada Kinkar Smriti Mahavidyalaya (iv) Nur Mohammad Smriti Mahavidyalaya	Role of Leadership in General Degree Colleges in view of NEP/SEP
21/04/2024	Inter-College Webinar	(i) Nabagram Amar Chand Kundu College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Lalgola College	Orientation program for TCS recruitment drive

OUTCOME:

- **The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.**
- **The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.**
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Jiaganj, Murshidabad, West Bengal, India

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

ACTIVITIES UNDER MOU

(2018-2023)

PEACE • PROGRESS • PROSPERITY

S. S. C

1949

SRIPAT SINGH COLLEGE

&

SUBHAS CHANDRA BOSE CENTENARY COLLEGE

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE
JIAGANJ
ESTD. 1949

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DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE
ESTD-
1949
JIAGANJ

The Memorandum of Understanding (MoU) signed between Colleges marks a significant milestone in the collaborative efforts of various institutions to enhance academic excellence, foster innovation, and promote cultural exchange. This partnership underscores the shared vision of both colleges to create a dynamic learning environment that transcends boundaries and nurtures the intellectual growth of students and faculty.

The primary purpose of the MoU is to establish a framework for cooperation in various academic and research endeavours. By formalizing their commitment to collaboration, both colleges aim to leverage their respective strengths and resources to achieve common goals. The MoU outlines key areas of cooperation, including joint research projects, faculty and student exchanges, sharing of academic resources, and the organization of collaborative events and workshops.

One of the core objectives of the MoU is to facilitate the exchange of knowledge and expertise between faculty members and students of both colleges. Through collaborative research projects and academic exchanges, students and faculty have the opportunity to gain new perspectives, broaden their horizons, and develop valuable skills that are essential for success in today's globalized world.

Another important aspect of the MoU is its focus on promoting innovation and entrepreneurship. By encouraging the sharing of ideas and best practices, both colleges aim to foster a culture of innovation that will drive technological advancement and economic growth in the region. Through joint initiatives such as innovation labs and startup incubators, students and faculty are encouraged to explore new ideas and turn them into viable business ventures.

Furthermore, the MoU emphasizes the importance of cultural exchange in promoting mutual understanding and respect among students and faculty. By organizing cultural events, language exchange programs, and regional study tours, both colleges seek to enrich the cultural experience of their students and promote intercultural dialogue.

DR. KAWAL KRISHNA SARKAR
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Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ★ JIAGANJ, MURSHIDABAD ★ ESTD- 1949

Since the signing of the MoU, both colleges have made significant progress in implementing its provisions. Few faculty and student exchanges have also been facilitated, allowing participants to benefit from new learning experiences and forge new academic partnerships.

In conclusion, the MoU between Colleges represents a commitment to excellence, innovation, and cultural enrichment. By working together, Colleges are paving the way for a brighter future, where academic collaboration knows no bounds, and students and faculty are empowered to achieve their full potential.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE
ESTD-1949
JIAGANJ, MSD.

1st Page of MoU


भारतीय गैर-न्यायिक

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Memorandum of understanding

Last Page of MoU

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE
ESTD-
1949
JIAGANJ, MSD.

Report on MOU for the Session 2018-19

Colleges under MOU:
Sripat Singh College, Jiaganj, Murshidabad
and
Subhas Chandra Bose Centenary College,Murshidabad

Date of Execution of MOU:	21/05/2018
Tenure of the MOU:	5 years

Purpose/ Objectives of MOU-

1.To promote academic excellence and innovation in education;
2.To facilitate the sharing of academic resources between the two institutions;
3.To share information and expertise in areas of mutual interest

Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
24/03/2019	Career Orientation Program	SCBC College	One day Career Orientation Program	60

OUTCOME:

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SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

DR. KAMAL KRISHNA SARKAR
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Sripat Singh College

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Dr.Supam Mukherjee
Principal
Sripat Singh College

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Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Report on MOU for the Session 2019-20

Colleges under MOU:

Sripat Singh College, Jiaganj, Murshidabad
and
Subhas Chandra Bose Centenary College,Murshidabad

Date of Execution of MOU:	21/05/2018
Tenure of the MOU:	5 years

Purpose/ Objectives of MOU-

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Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
26-02-2020	Special Class Communication skill	Mr.Shyam Sundar Sett (SSC)	Communication skill	50
28-02-2020	Special Class	Prof. Basundhara Ganguly	Career	68

OUTCOME:

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SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ-MSD.

Dr.Supam Mukherjee
Principal
SCBC College

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

Report on MOU for the Session 2020-21

Colleges under MOU:

Sripat Singh College, Jiaganj, Murshidabad
and
Subhas Chandra Bose Centenary College,Murshidabad

Date of Execution of MOU:	21/05/2018
Tenure of the MOU:	5 years

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Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
29-05-2021	Special Class	Mr. Shyam Sundar Sett (SSC)	Career Orientation Programme	81
11-05-2021	Special Class	Mr. Shyam Sundar Sett (SSC)	Career Orientation Programme	70
18-06-2021	Joint Webinar	Dr.Ramdas Chatterjee	Importance of vaccination	100

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SINGH COLLEGE ESTD-1949 JIAGANJ

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

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Webinar

Dr.Supam Mukherjee
Principal
SPBC College

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

SRIPAT SINGH COLLEGE
ESTD-1949
JIAGANJ

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

Report on MOU for the Session 2021-22

Colleges under MOU:

Sripat Singh College, Jiaganj, Murshidabad
and
Subhas Chandra Bose Centenary College, Murshidabad

Date of Execution of MOU:	21/05/2018
Tenure of the MOU:	5 years

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1.To promote academic excellence and innovation in education;
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Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
21-02-2022	Special Class	Mr.Sudipto Mukherjee (SCBC)	Communication skill	40
21-05-2022 & 28-05-2022	Inter-College Students Program	1. Nabagram Amar Chand Kundu College 2.Sripat Singh College 3.Subhas Chandra Bose Centenary College 4.Lalgola College	PowerPoint presentation competition	30

OUTCOME:

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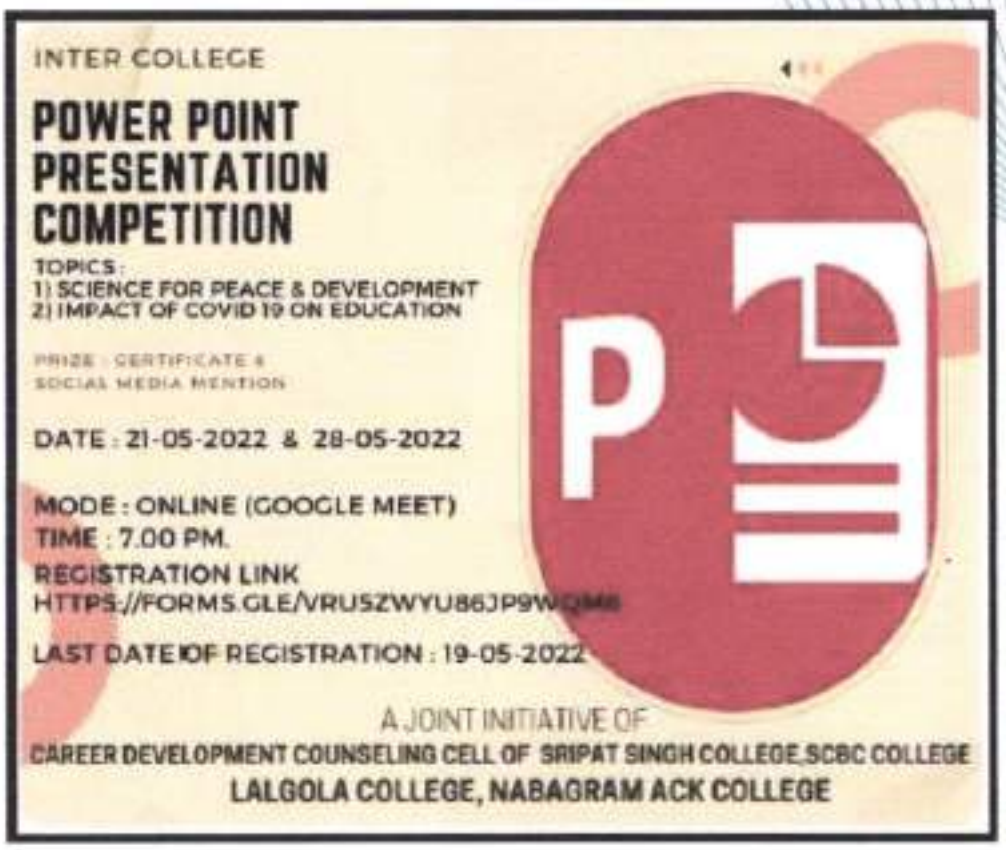
SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ

DR. KAMAL KRISHNA SARKA
Principal
Jiaganj, Murshidabad

Documentation



Dr.Supam Mukherjee
Principal
SCBC College

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

Report on MOU for the Session 2022-23

Colleges under MOU:

Sripat Singh College, Jiaganj, MurshidaMurshidabad
and
Subhas chandra Bose Centenary College

Date of Execution of MOU:	21/05/2018
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Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
03/07/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College	Webinar on plastic pollution: myth vs reality
20/07/2022	Campus Drive	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College	Campus Drive
28/08/2022	Inter College Student Competition	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College	Creative Writing competition on Azadi-Ki Amrit Mahotsav
27/08/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College	Webinar for WBCS Examination Preparation
28/12/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on the importance of the Entrepreneurial mindset of the students for future livelihood
30/12/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on the importance of financial literacy
15/03/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on scope and future in Retail Sector
26/04/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on scope and future in GEM- and Jewellery Sector
18/05/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on importance of soft skills for women's empowerment

SRIPAT SINGH COLLEGE ESTD. 1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Date of Activity	Nature of Activity	Resource Person / Organization	Topic
7/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on scope and future in green jobs
28/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on breaking barriers: Empowering Women in Entrepreneurship

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Principal
SCNC College

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ

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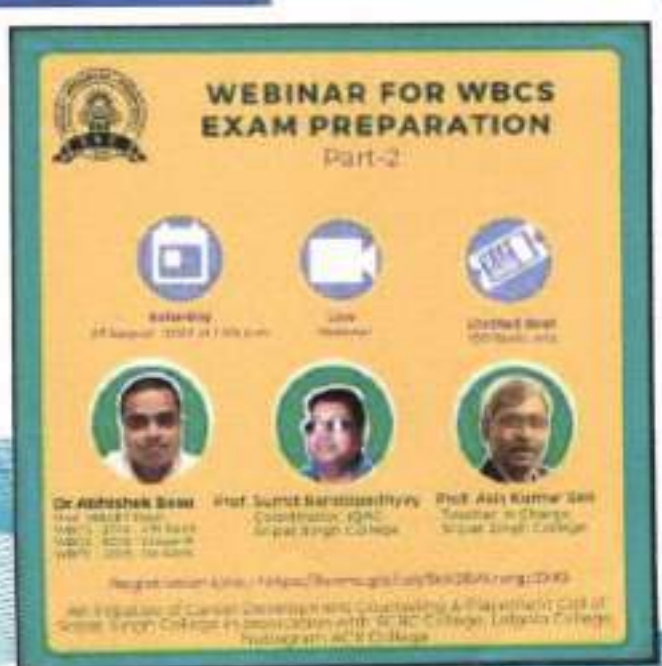

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SRIPAT SINGH COLLEGE ESTD. 1949 JIAGANJ, MSD

MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

LALGOLA COLLEGE ,

LALGOLA, MURSHIDABAD

AND

SRIPAT SINGH COLLEGE,

JIAGANJ, MURSHIDABAD

Tapan Barc.
Principal
Lalgola College
Lalgola, Murshidabad

In continuation of the MOU signed on **May 21, 2018, between Lalgola College and Sripat Singh College, we hereby formalize and extend this agreement on September 27, 2023** between **Lalgola College, Lalgola, Murshidabad** and **Sripat Singh College Jiaganj, Murshidabad** (hereinafter referred to as "First Party") and **Sripat Singh College, Jiaganj, Murshidabad** (hereinafter referred to as" Second party").

Whereas, both Parties share a common goal of providing high-quality academic facilities for their respective students. and

Whereas, both Parties wish to collaborate and cooperate for the betterment of academic facilities and the advancement of education.

Report on MOU for the Session 2018-19

Colleges under MOU: Lalgola College, Lalgola, Murshidabad

And

Sripat Singh College, Jiaganj, Murshidabad, Pin-742123

1. **Date of Execution of MOU:** 21/05/2018
2. **Tenure of the MOU:** 5 years
3. **Purpose/ Objectives of MOU-**
   - **To promote academic excellence and innovation in education;**
   - **To facilitate the sharing of academic resources between the two institutions;**
   - **To share information and expertise in areas of mutual interest**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
3/10/2018	Inter-College quiz Competition	Shyamsundar Sett	Quiz Competition	58
08/03/2019	Collaborative Seminar	CINI (Child -in-Need Institute)	One-day seminar on preventive measures against women trafficking	49

Tapan Bar.
Principal
Lalgola College
Lalgola, Murshidabad

15.6.24
DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD. 1949

OUTCOME:

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15.6.24

Dr. Kamal Krishna Sarkar
Principal
Sripat Singh College, Jiaganj, Murshidabad, Pin-742123Murshidabad, West Bengal, India

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

Tapan Bar.

Dr. Tapan Bar
Principal
Lalgola College, Lalgola
Murshidabad, West Bengal, India

Principal
Lalgola College
Lalgola, Murshidabad

Report on MOU for the Session 2019-20

Colleges under MOU:

Lalgola College, Lalgola, Murshidabad, Pin-742148

And

Sripat Singh College, Jiaganj, Murshidabad, Pin-742123

1. **Date of Execution of MOU:** **21/05/2018**
2. **Tenure of the MOU:** **5 years**
3. **Purpose/ Objectives of MOU-**
   - **To promote academic excellence and innovation in education;**
   - **To facilitate the sharing of academic resources between the two institutions;**
   - **To share information and expertise in areas of mutual interest**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic	No. of Faculty & Students Benefitted
21/05/2019	Special Class	Dr. Amal Modak(Bengali) Sripat Singh College(English) Lalgola College	Indian Folk-Culture	22
13/08/2019	Special Class	Faruk Abdulla (Philosophy) Sripat Singh College	Concept of Gandhi In Indian Philosophy	30

Tapan Bate.
Principal
Lalgola College
Lalgola,Murshidabad

15.6.24
DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

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Dr. Kamal Krishna Sarkar
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DR. KAMAL KRISHNA SARKAR
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Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

Tapan Bar

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Dr. Tapan Bar
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Principal
Lalgola College
Lalgola,Murshidabad

Report on MOU for the Session

2021-22

Colleges under MOU: Lalgola College, Lalgola, Murshidabad, Pin-742148

and

Sripat Singh College, Jiaganj, Murshidabad, 742123

1. **Date of Execution of MOU:** **21/05/2018**
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   - **To share information and expertise in areas of mutual interest.**

4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
22/07/2021	Inter-College Webinar	(i) Lalgola College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Nabagram Amar Chand Kundu College	Orientation Programme on Central Armed Forces
30/11/2021	Inter-College Webinar	(i) Lalgola College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Nabagram Amar Chand Kundu College	Webinar on Financial Literacy

Tapan Bose.
Principal
Lalgola College
Lalgola, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

DR. KAMAL KRISHNA SARKAR
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Sripat Singh College
Jiaganj, Murshidabad

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Principal
Sripat Singh College, Jiaganj, Murshidabad, Pin-742123 Murshidabad, West Bengal, India

DR. KAMAL KRISHNA SARKAR
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Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949

Tapan Bar

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Principal
Lalgola College, Lalgola, Murshidabad, Pin-742148 West Bengal, India

Principal
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Lalgola,Murshidabad

Report on MOU for the Session

2022-23

Colleges under MOU: Lalgola College, Lalgola, Murshidabad, Pin-742148

and

Sripat Singh College, Jiaganj, Murshidabad, 742123

1. **Date of Execution of MOU:** **21/05/2018**
2. **Tenure of the MOU:** **5 years**
3. **Purpose/ Objectives of MOU-**
   - **To promote academic excellence and innovation in education.**
   - **To facilitate the sharing of academic resources between the two institutions.**
   - **To collaborate in the development of new educational programs and initiatives in accordance with the directives of NEP 2020.**
   - **To share information and expertise in areas of mutual interest.**
4. **Activities conducted under MOU: -**

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
20/07/2022	Inter-College Webinar	(i) Lalgola College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Nabagram Amar Chand Kundu College	Campus drive by Fusion BEO
17/08/2022	Inter-College Webinar	(i) Lalgola College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Nabagram Amar Chand Kundu College	Career Orientation Programme on SSC
28/12/2022	Inter-College Webinar	(i) Lalgola College (ii) Sripat Singh College (iii) Subhas Chandra Bose Centenary College (iv) Nabagram Amar Chand Kundu College	Webinar on Entrepreneurship

Tapan Bose
Principal
Lalgola College
Lalgola, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949

DR. KAMALKRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

15/03/2023	Campus Drive	TCS	Placement

OUTCOME:

- **The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.**
- **The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.**
- **The practice of academic exchange has proved to be very helpful in developing a healthy mutual relationship leading to the holistic development of both institutions.**

15.6.24

Dr. Kamal Krishna Sarkar
Principal
Sripat Singh College, Jiaganj, Murshidabad, Pin-742123Murshidabad, West Bengal, India

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

Tapan Bar

Dr. Tapan Bar
Principal
Lalgola College, Lalgola, Murshidabad, Pin-742148 West Bengal, India

Principal
Lalgola College
Lalgola,Murshidabad

ACTIVITIES UNDER MOU

(2018-2023)

PEACE • PROGRESS • PROSPERITY

S. S. C

1949

SRIPAT SINGH COLLEGE

&

NAGAR COLLEGE

SRIPAT SINGH COLLEGE ESTD- 1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

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SRIPAT SINGH COLLEGE ESTD- 1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA [illegible]
Principal
Sripat Singh College
Jiaganj, Murshidabad

The Memorandum of Understanding (MoU) signed between Colleges marks a significant milestone in the collaborative efforts of various institutions to enhance academic excellence, foster innovation, and promote cultural exchange. This partnership underscores the shared vision of both colleges to create a dynamic learning environment that transcends boundaries and nurtures the intellectual growth of students and faculty.

The primary purpose of the MoU is to establish a framework for cooperation in various academic and research endeavours. By formalizing their commitment to collaboration, both colleges aim to leverage their respective strengths and resources to achieve common goals. The MoU outlines key areas of cooperation, including joint research projects, faculty and student exchanges, sharing of academic resources, and the organization of collaborative events and workshops.

One of the core objectives of the MoU is to facilitate the exchange of knowledge and expertise between faculty members and students of both colleges. Through collaborative research projects and academic exchanges, students and faculty have the opportunity to gain new perspectives, broaden their horizons, and develop valuable skills that are essential for success in today's globalized world.

Another important aspect of the MoU is its focus on promoting innovation and entrepreneurship. By encouraging the sharing of ideas and best practices, both colleges aim to foster a culture of innovation that will drive technological advancement and economic growth in the region. Through joint initiatives such as innovation labs and startup incubators, students and faculty are encouraged to explore new ideas and turn them into viable business ventures.

Furthermore, the MoU emphasizes the importance of cultural exchange in promoting mutual understanding and respect among students and faculty. By organizing cultural events, language exchange programs, and regional study tours, both colleges seek to enrich the cultural experience of their students and promote intercultural dialogue.

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Since the signing of the MoU, both colleges have made significant progress in implementing its provisions. Few faculty and student exchanges have also been facilitated, allowing participants to benefit from new learning experiences and forge new academic partnerships.

In conclusion, the MoU between Colleges represents a commitment to excellence, innovation, and cultural enrichment. By working together, Colleges are paving the way for a brighter future, where academic collaboration knows no bounds, and students and faculty are empowered to achieve their full potential.

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

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RS.50 RS.50

INDIA NON JUDICIAL

পশ্চিম বঙ্গ पश्चिम बंगाल WEST BENGAL AB 740121

Memorandum of Understanding

Between

Sripat Singh College,P.O+P.S.Jiaganj,Dist.Murshidabad,Pin-742123

&

Nagar College,PO:Nagar,P.S.Khargram,Dist.Murshidabad,Pin-742203

This agreement is entered into on 24 September, 2022 by and between Sripat Singh College,P.O+P.S.Jiaganj,Dist.Murshidabad,Pin-742123 and Nagar College ,P.O: Nagar,P.S.Khargram,Dist.Murshidabad,Pin-742203.

The aforesaid institutions are referred to individually as institute and collectively as institutions.

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SRIPAT SINGH COLLEGE ESTD 1948 JIAGANJ, MSD

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Report on MOU for the Session 2022-23

Colleges under MOU:

Sripat Singh College, Jiaganj, MurshidaMurshidabad
and
Nagar College

Date of Execution of MOU:	24-9-2022
Tenure of the MOU:	5 years

Purpose/ Objectives of MOU-

1.To promote academic excellence and innovation in education;
2To facilitate the sharing of academic resources between the two institutions;
3.To share information and expertise in areas of mutual interest

Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
28/12/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on the importance of the Entrepreneurial mindset of the students for future livelihood
30/12/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on the importance of financial literacy
26/04/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on scope and future in Retail Sector
15/03/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on scope and future in GEM- and Jewellery Sector
18/05/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on importance of soft skills for women's empowerment

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. [illegible] SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Date of Activity	Nature of Activity	Resource Person / Organization	Topic
7/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on scope and future in green jobs
28/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on breaking barriers: Empowering Women in Entrepreneurship

OUTCOME:

1.The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.

2.The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.

3.The practice of academic exchange has proved to be very helpful in developing a heal mutual relationship leading to the holistic development of both institutions.

Dr. Anilesh Dey
Principal
Nagar College

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

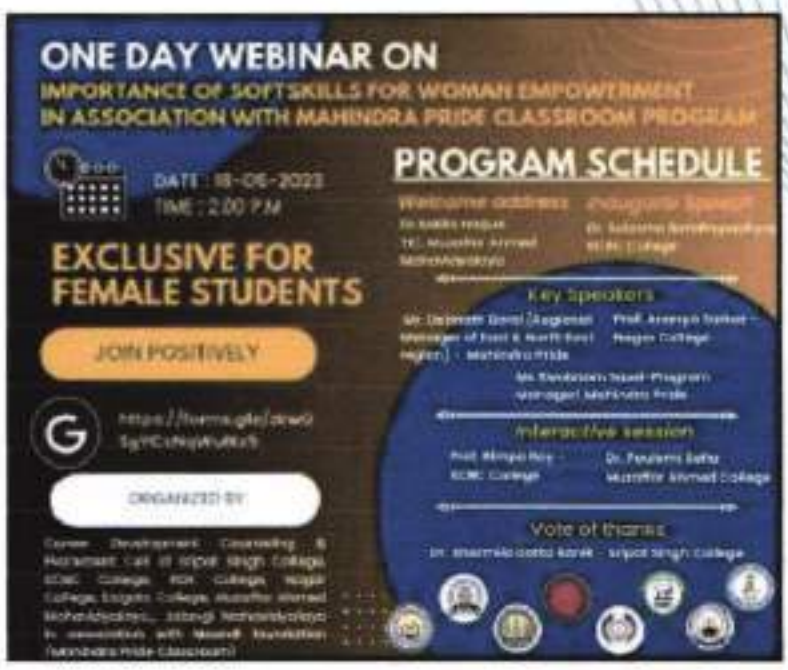
DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation



SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAKRISHNA SARKAR
Principal
Sripat Singh College

Documentation

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

ACTIVITIES UNDER MOU

(2018-2023)

PEACE • PROGRESS • PROSPERITY

S. S. C

1949

SRIPAT SINGH COLLEGE

&

JALANGI MAHAVIDYALAYA

SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

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SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Since the signing of the MoU, both colleges have made significant progress in implementing its provisions. Few faculty and student exchanges have also been facilitated, allowing participants to benefit from new learning experiences and forge new academic partnerships.

In conclusion, the MoU between Colleges represents a commitment to excellence, innovation, and cultural enrichment. By working together, Colleges are paving the way for a brighter future, where academic collaboration knows no bounds, and students and faculty are empowered to achieve their full potential.

SNIPAT SINGH COLLEGE ESTD 1949

DR. KAMAL KRISHNA SARKAR
Principal
Snipat Singh College
Jiaganj, Murshidabad

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पश्चिमबंगाल पश्चिम बंगाल WEST BENGAL
Memorandum of Understanding

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On behalf of Sripat Singh College
Teacher in Charge
Coordinator IQAC
On behalf of Jalangi Mahavidyalaya
Teacher in Charge
Coordinator IQAC

SINGH COLLEGE
EST. 1949

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Report on MOU for the Session 2022-23

Colleges under MOU:

Sripat Singh College, Jiaganj, MurshidaMurshidabad
and
Jalangi Mahavidyalaya

Date of Execution of MOU:	28-9-2022
Tenure of the MOU:	5 years

Purpose/ Objectives of MOU-

1.To promote academic excellence and innovation in education;
2To facilitate the sharing of academic resources between the two institutions;
3.To share information and expertise in areas of mutual interest

Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
28/12/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on the importance of the Entrepreneurial mindset of the students for future livelihood
30/12/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on the importance of financial literacy
26/04/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on scope and future in Retail Sector
15/03/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on scope and future in GEM- and Jewellery Sector
18/05/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on importance of soft skills for women's empowerment

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

Date of Activity	Nature of Activity	Resource Person / Organization	Topic
7/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on scope and future in green jobs
28/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on breaking barriers: Empowering Women in Entrepreneurship

OUTCOME:

1.The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.

2.The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.

3.The practice of academic exchange has proved to be very helpful in developing a heal mutual relationship leading to the holistic development of both institutions.

Dr. Indranil Mondal
Principal
Jalangi Mahavidyalaya

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

SRIPAT SINGH COLLEGE
ESTD-1949
JIAGANJ, MSD.

DR. KAMAL KRISHNA SARK
Principal
Sripat Singh College
Jiaganj

Documentation

SRIPAT SINGH COLLEGE ESTD-1949

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

SRIPAT SINGH COLLEGE ESTD 1949 JIAGANJ

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

ACTIVITIES UNDER MOU

(2018-2023)

PEACE • PROGRESS • PROSPERITY

S. S. C

1949

SRIPAT SINGH COLLEGE

&

MUZAFFAR AHMED MAHAVIDYALAYA

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

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Principal
Ekpat Singh College
Jagani, Murahidabad

The Memorandum of Understanding (MoU) signed between Colleges marks a significant milestone in the collaborative efforts of various institutions to enhance academic excellence, foster innovation, and promote cultural exchange. This partnership underscores the shared vision of both colleges to create a dynamic learning environment that transcends boundaries and nurtures the intellectual growth of students and faculty.

The primary purpose of the MoU is to establish a framework for cooperation in various academic and research endeavours. By formalizing their commitment to collaboration, both colleges aim to leverage their respective strengths and resources to achieve common goals. The MoU outlines key areas of cooperation, including joint research projects, faculty and student exchanges, sharing of academic resources, and the organization of collaborative events and workshops.

One of the core objectives of the MoU is to facilitate the exchange of knowledge and expertise between faculty members and students of both colleges. Through collaborative research projects and academic exchanges, students and faculty have the opportunity to gain new perspectives, broaden their horizons, and develop valuable skills that are essential for success in today's globalized world.

Another important aspect of the MoU is its focus on promoting innovation and entrepreneurship. By encouraging the sharing of ideas and best practices, both colleges aim to foster a culture of innovation that will drive technological advancement and economic growth in the region. Through joint initiatives such as innovation labs and startup incubators, students and faculty are encouraged to explore new ideas and turn them into viable business ventures.

Furthermore, the MoU emphasizes the importance of cultural exchange in promoting mutual understanding and respect among students and faculty. By organizing cultural events, language exchange programs, and regional study tours, both colleges seek to enrich the cultural experience of their students and promote intercultural dialogue.

Since the signing of the MoU, both colleges have made significant progress in implementing its provisions. Few faculty and student exchanges have also been facilitated, allowing participants to benefit from new learning experiences and forge new academic partnerships.

In conclusion, the MoU between Colleges represents a commitment to excellence, innovation, and cultural enrichment. By working together, Colleges are paving the way for a brighter future, where academic collaboration knows no bounds, and students and faculty are empowered to achieve their full potential.

DR. KAMAL KRISHNA BARUAH
Principal
Sripat Singh College
Jiaganj, Murshidabad

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Memorandum of Understanding

Last Page of MoU

BANKIMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Report on MOU for the Session 2022-23

Colleges under MOU:

Sripat Singh College, Jiaganj, MurshidaMurshidabad
and
Muzaffar Ahmed Mahavidyalaya ,Salar, Murshidabad

Date of Execution of MOU:	29-11-2022
Tenure of the MOU:	5 years

Purpose/ Objectives of MOU-

1.To promote academic excellence and innovation in education;
2To facilitate the sharing of academic resources between the two institutions;
3.To share information and expertise in areas of mutual interest

Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
28/12/2022	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya	Webinar on the importance of the Entrepreneurial mindset of the students for future livelihood
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DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Date of Activity	Nature of Activity	Resource Person / Organization	Topic
7/06/2023	Inter-College Webinar	Sripat Singh College Natagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on scope and future in green jobs
28/06/2023	Inter-College Webinar	Sripat Singh College Natagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on breaking barriers: Empowering Women in Entrepreneurship

OUTCOME:

1.The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.

2.The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.

3.The practice of academic exchange has proved to be very helpful in developing a heal mutual relationship leading to the holistic development of both institutions.

Dr. Karunamoy Chatterjee
Principal
Mutsaddi Ahmed Mahavidyalaya

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

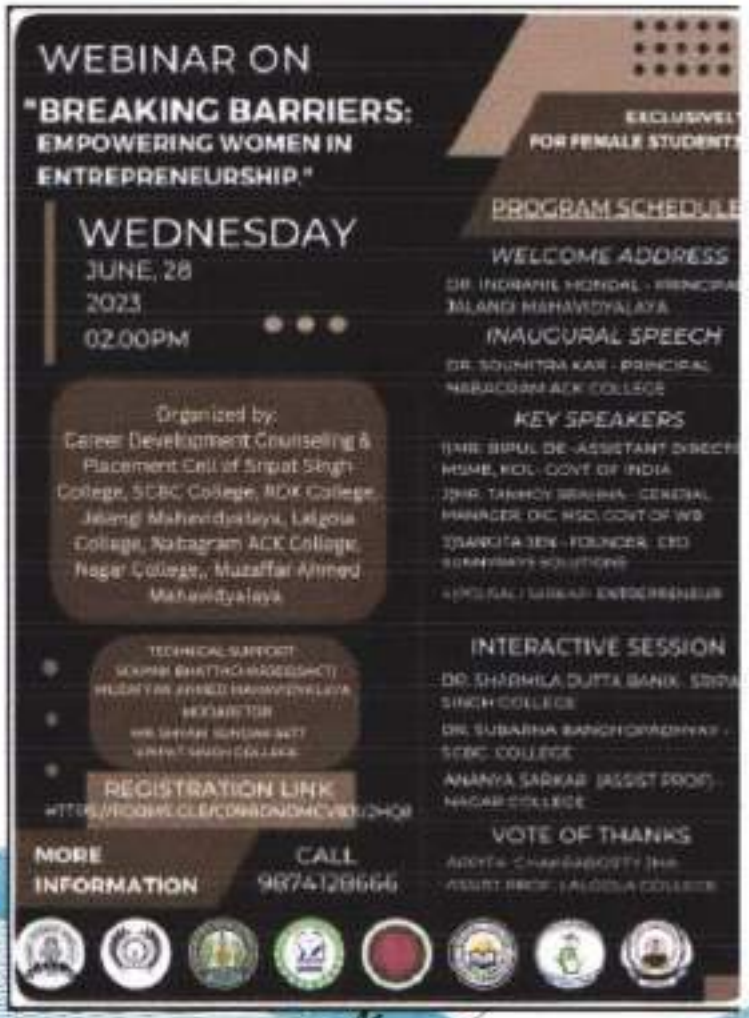
Documentation

DR. KAMAL KRISHNA SARKAR

Documentation

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation



DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation

DR. KAMAL KRISHNA SARKAR
Principal
Jiaganj, Murshidabad

Documentation

Join

WEBINAR ON

IMPORTANCE OF FINANCIAL LITERACY

30 December 2022

02:30 - 4.00 P.M.

Organized by Career Development Counselling & Placement Cell of Sripat Singh College, SCBC College, Laigola College, Nabagram Amar Chand Kundu College, Nagar College,Jalangi Mahavidyalaya, Muzaffar Ahmed Mahavidyalaya

Register Now
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PLATFORM : GOOGLE MEET

Prof(Dr)Raman Ballabh
Resource Person at CGSL IPF & Indian Institute of Corporate Affairs , ICAI
NISM
National Institute of Securities Markets (NISM) Indian Institute of Corporate Affairs, Tata Institute of Social Sciences

Prof(Dr) Sakila Haque
Teacher in Charge
Muzaffar Ahmed Mahavidyalaya (Solar)

REGISTER

Prof. Shameek Ghosh
Teacher in Charge
Jalangi Mahavidyalaya

Prof. Abhijit Bhattcharyya
Teacher in Charge
Nabagram Amar Chand Kundu College

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

ACTIVITIES UNDER MOU

(2018-2023)

PEACE • PROGRESS • PROSPERITY

S. S. C

1949

SRIPAT SINGH COLLEGE

&

RANI DHANYA KUMARI COLLEGE

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

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SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

The Memorandum of Understanding (MoU) signed between Colleges marks a significant milestone in the collaborative efforts of various institutions to enhance academic excellence, foster innovation, and promote cultural exchange. This partnership underscores the shared vision of both colleges to create a dynamic learning environment that transcends boundaries and nurtures the intellectual growth of students and faculty.

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Another important aspect of the MoU is its focus on promoting innovation and entrepreneurship. By encouraging the sharing of ideas and best practices, both colleges aim to foster a culture of innovation that will drive technological advancement and economic growth in the region. Through joint initiatives such as innovation labs and startup incubators, students and faculty are encouraged to explore new ideas and turn them into viable business ventures.

Furthermore, the MoU emphasizes the importance of cultural exchange in promoting mutual understanding and respect among students and faculty. By organizing cultural events, language exchange programs, and regional study tours, both colleges seek to enrich the cultural experience of their students and promote intercultural dialogue.

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Since the signing of the MoU, both colleges have made significant progress in implementing its provisions. Few faculty and student exchanges have also been facilitated, allowing participants to benefit from new learning experiences and forge new academic partnerships.

In conclusion, the MoU between Colleges represents a commitment to excellence, innovation, and cultural enrichment. By working together, Colleges are paving the way for a brighter future, where academic collaboration knows no bounds, and students and faculty are empowered to achieve their full potential.

SRIPAT SINGH COLLEGE
ESTD-1949
JIAGANJ, MSD.

Principal
Sripat Singh College
Jiaganj, Murshidabad

1st Page of MoU


INDIA NON JUDICIAL

Last Page of MoU

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ MURSHIDABAD

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Report on MOU for the Session 2022-23

Colleges under MOU:

Sripat Singh College, Jiaganj, MurshidaMurshidabad
and
Rani Dhanya Kumari College ,Jiaganj, Murshidabad

Date of Execution of MOU:	29-3-2023
Tenure of the MOU:	10 Years

Purpose/ Objectives of MOU-

1.To promote academic excellence and innovation in education;
2To facilitate the sharing of academic resources between the two institutions;
3.To share information and expertise in areas of mutual interest

Activities conducted under MOU: -

Date of Activity	Nature of Activity	Resource Person/Organization	Topic
26/04/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on scope and future in GEM- and jewellery Sector
18/05/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on importance of soft skills for women's empowerment

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Principal
Sripat Singh College
Jiaganj, Murshidabad

Date of Activity	Nature of Activity	Resource Person / Organization	Topic
7/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	One-day webinar on scope and future in green jobs
28/06/2023	Inter-College Webinar	Sripat Singh College Nabagram Amar Chand Kundu College Subhas Chandra Bose Centenary College Lalgola College,Jalangi Mahavidyalaya, Nagar College ,MA Mahavidyalaya ,RDK College	Webinar on breaking barriers: Empowering Women in Entrepreneurship

OUTCOME:

1.The Faculty Exchange Programme, conducted under an MOU, has enabled the college to provide students with quality academic exposure and the opportunity to interact with faculty members specializing in various fields of study.

2.The faculty members also had the opportunity to interact with each other and share their views on the teaching and learning process.

3.The practice of academic exchange has proved to be very helpful in developing a heal mutual relationship leading to the holistic development of both institutions.

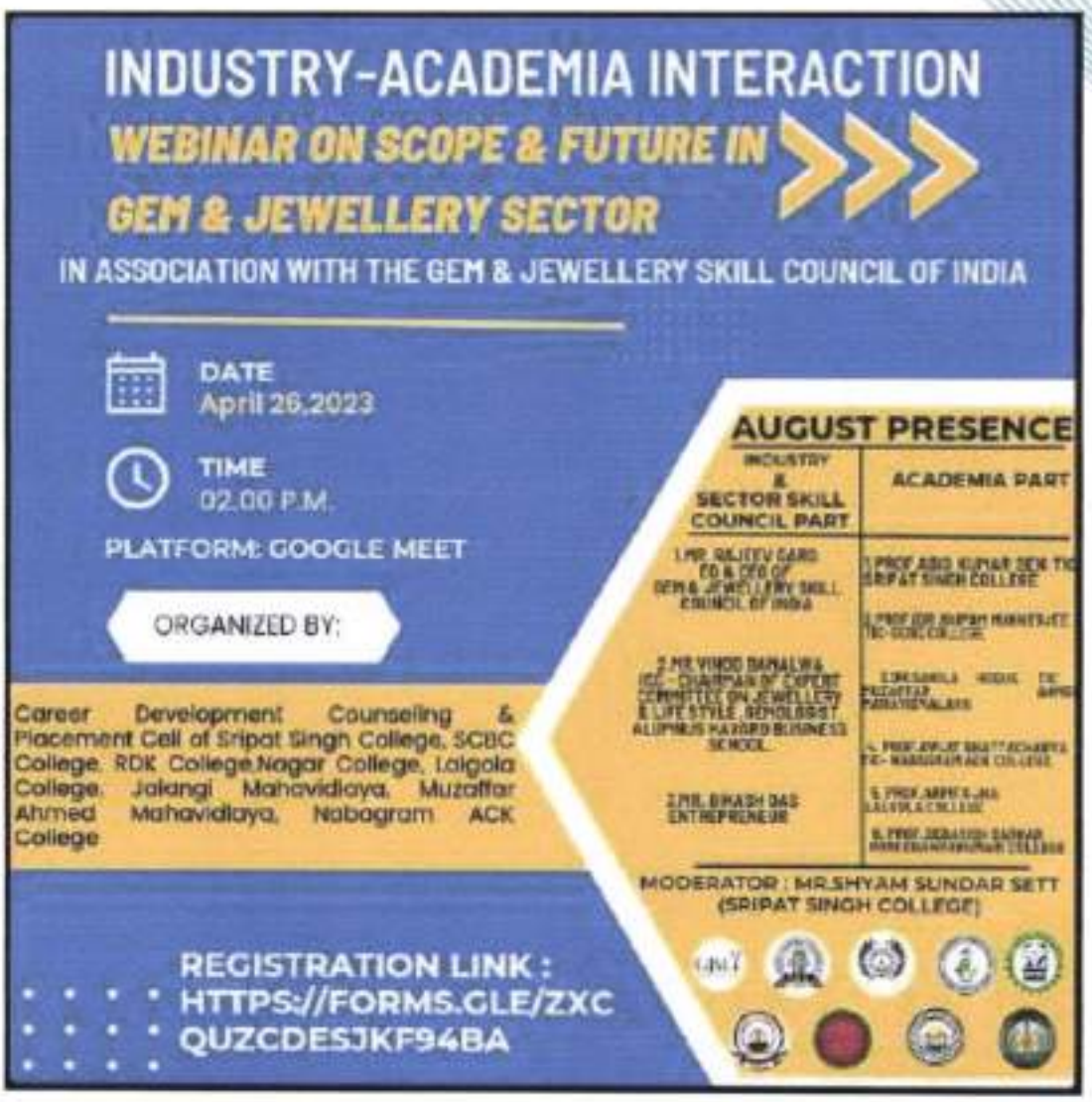
Dr. Ajoy Adhikari
Principal
RDK College

Dr.Kamal Krishna Sarkar
Principal
Sripat Singh College

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ

Documentation



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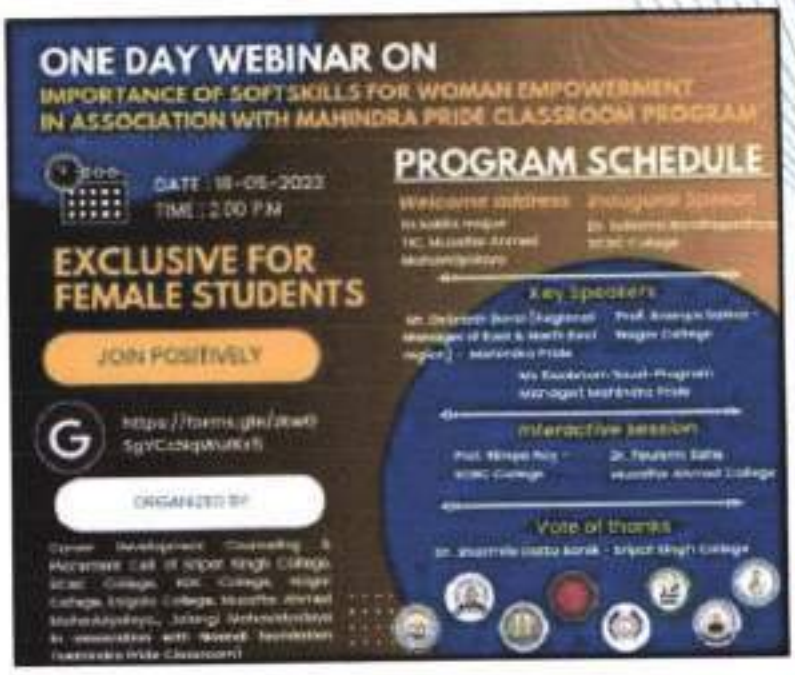
DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Documentation



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Principal
Sripat Singh College
Jiaganj

Documentation

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

MEMORANDUM
OF UNDERSTANDING

Between

Dr.Sagar Simlandy

Mr.Keshab Chandra Ghosh

DR. KAMAL KRISHNA SARKAR
Principal
Surgat Singh College

Memorandum of Understanding

This Memorandum of Understanding (hereinafter called the MOU) is signed on the 15th day of March, 2021 between Dr. Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Keshab Chandra Ghosh, Assistant Professor of History, Jangipur College, Jangipur, Murshidabad, regarding research collaborations on two edited books: "Revisiting The History of India & Beyond" and "Colonial Origins of Modernity in India: Society, Polity, and Culture."

Clauses of MoU

1. Both signing parties will adhere to research ethics, share ideas, and avoid any conflict of interest while publishing any documents or research articles.
2. Both parties will utilize research grants from any source for the fulfillment of the project.

Time Period of Collaboration

This collaboration will remain in effect until one of the signing parties wishes to withdraw from the MOU.

Signed

First Party: Sagar Simlandy

Second Party: Keshab Chandra Ghosh

Functionality of the MOU

Within the purview of the MOU signed between Dr. Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Keshab Chandra Ghosh, Assistant Professor of History, Jangipur College, Jangipur, Murshidabad, the following outcomes were obtained:

- Edited book, "Revisiting The History of India & Beyond," published by Online Gatha - The Endless Tale, Lucknow, in June 2021, ISBN 978-93-90388-94-3.
- Edited book, "Colonial Origins of Modernity in India: Society, Polity, and Culture," published by BFC Publications, Lucknow, in August 2022, ISBN 978-93-5632-427-5.

Signed: Dated the 15th March 2021

First Party: Sagar Simlandy

Second Party: Keshab Chandra Ghosh

Signature of Principal with Seal

Sripat Singh College: _____

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

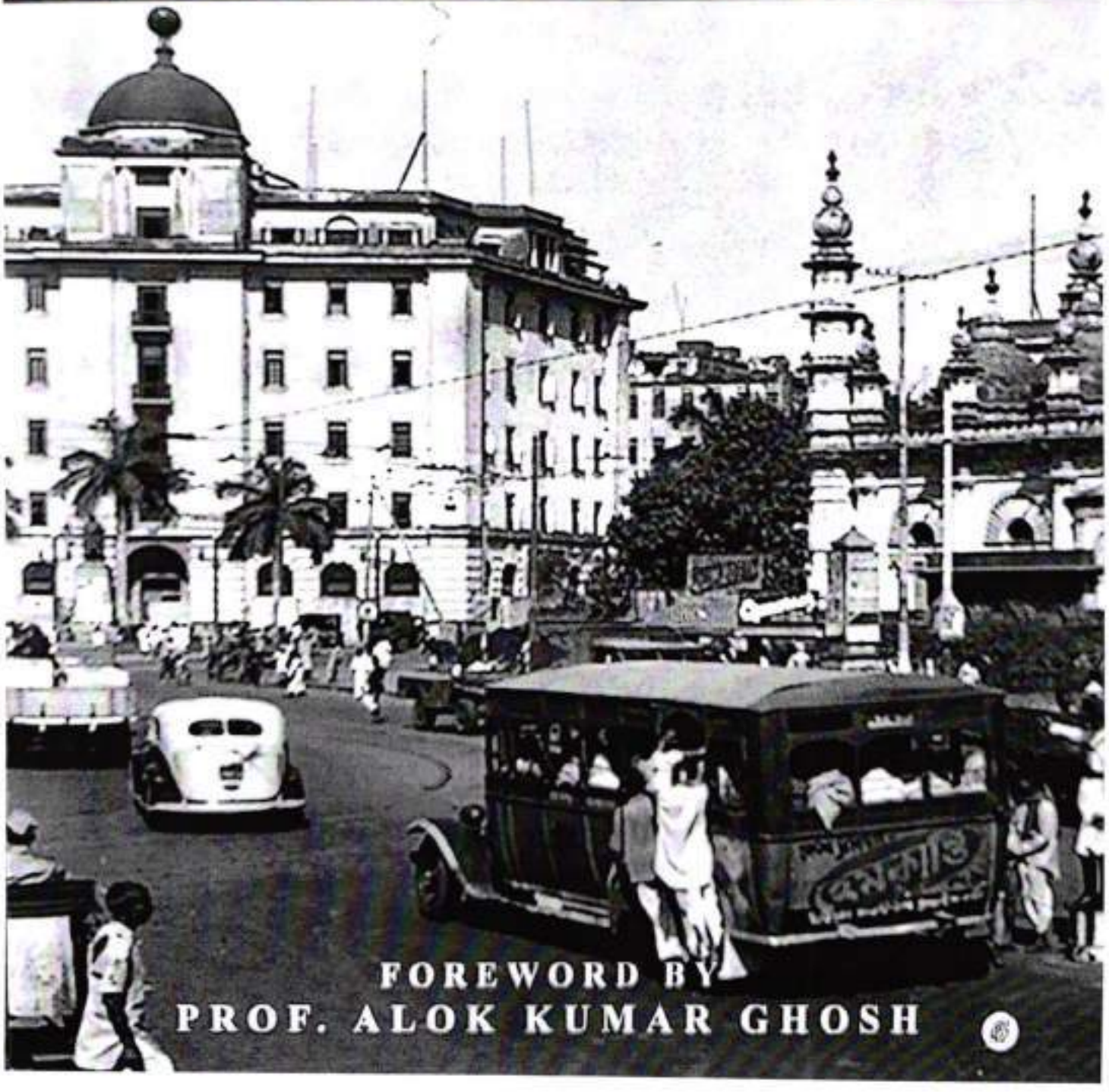
SRIPAT SINGH COLLEGE * ESTD-1949 * JIAGANJ

Jangipur College: _____

COLONIAL ORIGINS OF MODERNITY IN INDIA

SOCIETY, POLITY AND CULTURE

EDITED BY
SAGAR SIMLANDY
KESHAB CHANDRA GHOSH



FOREWORD BY
PROF. ALOK KUMAR GHOSH

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BFC PUBLICATIONS

Published by:
BFC Publications Private Limited
CP-61, Viraj Khand, Gomti Nagar,
Lucknow-226010

First Edition-August,2022

ISBN - 978-93-5632-427-5

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MEMORANDUM
OF UNDERSTANDING

Between

Dr.Sagar Simlandy

Mr. Ganesh Kr. Mandal

DR. KAMAL KRISHNA SARKAR
Principal
Sagat Singh College
Jiaganj, Murshidabad

Memorandum of Understanding

This Memorandum of Understanding (hereinafter called the MOU) is signed on the 15th day of March, 2021 between Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Ganesh Kr. Mandal, Assistant Professor of History, Berhampore Girl's College, Berhampore, Murshidabad, regarding research collaborations in two edited books on "Taking another look at the History of India & Abroad".

Clauses of MoU

1. Both signing parties will adhere to research ethics, share ideas, and avoid any conflict of interest while publishing any documents or research articles.
2. Both parties will utilize research grants from any source for the fulfillment of the project.

Time Period of Collaboration

This collaboration will remain in effect until one of the signing parties wishes to withdraw from the MOU.

Signed

First Party: Sagar Simlandy

Second Party: Ganesh Kr. Mandal

Functionality of the MOU

Within the purview of the MOU signed between Mr. Sagar Simlandy, Assistant Professor, Dept. of History, Sripat Singh College, Jiaganj, Murshidabad, and Ganesh Kr. Mandal, Assistant Professor of History, Berhampore Girl's College, Berhampore, Murshidabad, the following outcomes were obtained:

- Edited book, "Taking another look at the History of India & Abroad," published by BFC Publication, Lucknow, in August 2021, ISBN 978-93-90880-12-6.

Signed: Dated the 15th April, 2021

First Party: Sagar Simlandy

Second Party: Ganesh Kr. Mandal

Signature of Principal with Seal

Sripat Singh College: _____

Berhampore Girl's College: _____

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

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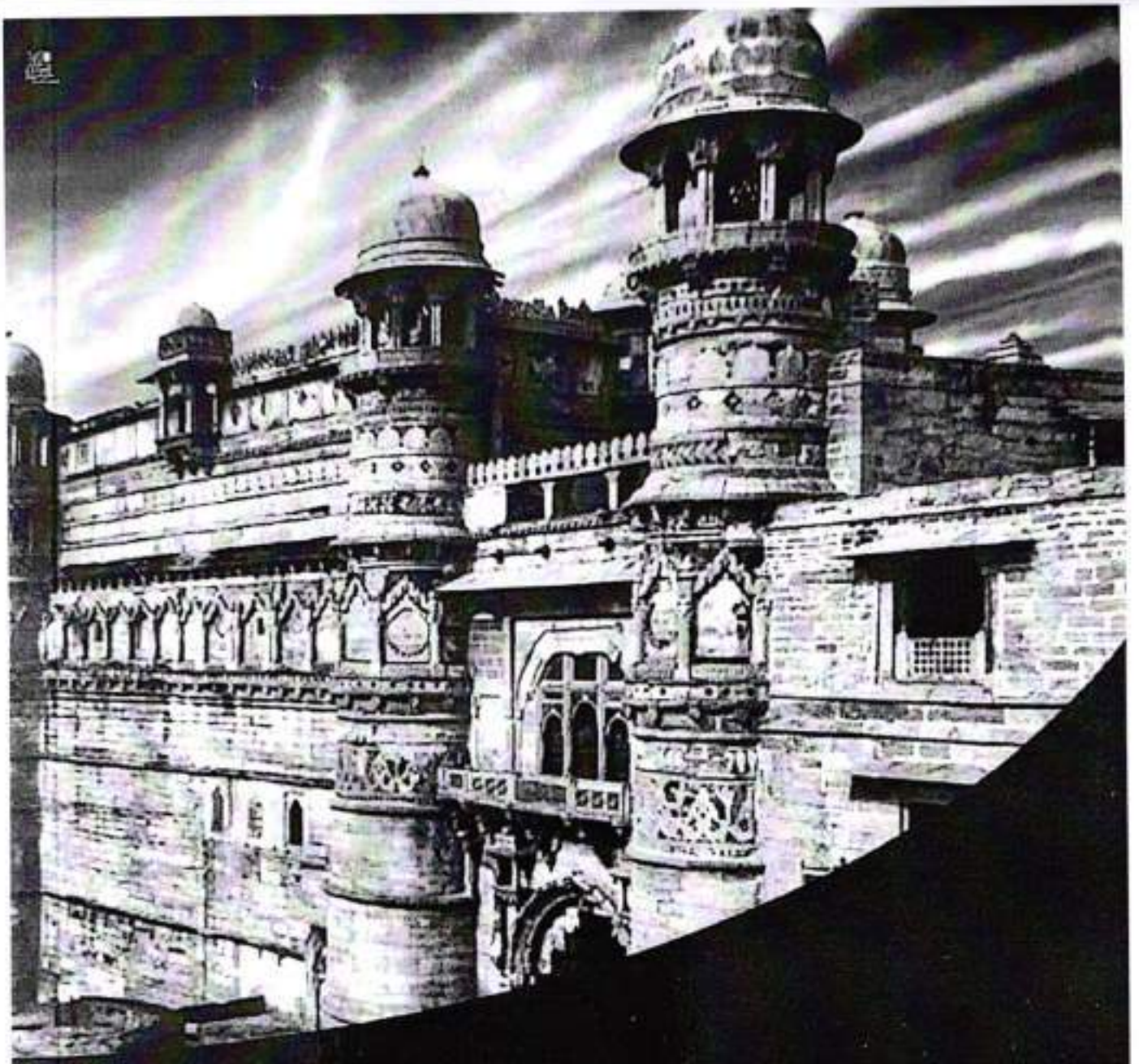

Taking another look at the History of India & Abroad

Sagar Simlandy
Ganesh Kr. Mandal

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BFC PUBLICATIONS

Published by:
BFC Publications Private Limited
CP-61, Viraj Khand, Gomti Nagar,
Lucknow-226010

ISBN - 978-93-90880-12-6

Year - 2021

Price - ₹ 450

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MEMORANDUM
OF UNDERSTANDING

Between

Mr. Sudhanshu Kumar Biswas

Dr. Uttam Ghosh

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

Memorandum of Understanding

This Memorandum of Understanding (hereinafter called the MOU) is signed on the 21st day of March, 2020 between:

- Mr. Sudhanshu Kumar Biswas, Assistant Professor, Department of Mathematics, Sripat Singh College, Jiaganj, Murshidabad

and

- Dr. Uttam Ghosh, Assistant Professor, Department of Applied Mathematics, University of Calcutta, 92 APC Road, Kolkata 700009

regarding Research Collaborations in four published research articles on Mathematical Disease Modelling.

Clauses of MOU

1. Research Ethics and Conflict of Interest: Both signing parties will adhere to strict research ethics, share ideas, and avoid any conflict of interest in the publication of documents or research articles.

2. Utilization of Research Grants: Both parties agree to utilize research grants from any source for the fulfillment of the project.

Time Period of Collaboration

This MOU will remain effective until one of the signing parties wishes to withdraw from the agreement.

Functionality of the MOU

Under this MOU, the following research publications were achieved:

1. COVID-19 Pandemic in India: A Mathematical Model Study, Nonlinear Dynamics, 102: 537-553, 2020.
2. Mathematical Modelling of COVID-19: A Case Study of Italy, Mathematics and Computers in Simulation, 194, 1-18, 2022.
3. An SEQAIHR Model to Study COVID-19 Transmission and Optimal Control Strategies in Hong Kong, Nonlinear Dynamics, 111, 6873-6893, 2022.
4. Effect of Sexual and Vertical Transmission on Zika Virus Dynamics under Environmental Fluctuations, International Journal of Biomathematics, 2450019, DOI: S1793524524500190, 2024.

Signatories

First Party:
Mr. Sudhanshu Kumar Biswas
Assistant Professor, Department of Mathematics,
Sripat Singh College, Jiaganj, Murshidabad

Second Party:
Dr. Uttam Ghosh
Assistant Professor, Department of Applied Mathematics,
University of Calcutta, 92 APC Road, Kolkata 700009

Dated:March 21, 2020

Signatures:

1. Sudhanshu Kr. Biswas, (Mr. Sudhanshu Kumar Biswas)
2. _____ (Dr. Uttam Ghosh)

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE
1949
JIAGANJ, MSD.

Memorandum of Understanding

This Memorandum of Understanding (here in after called the MOU) is signed on the 21 Day of March, 2020 between **Mr. Sudhanshu Kumar Biswas**, Assistant Professor, Dept. of Mathematics, Sripat Shing College, Jiaganj, Murshidabad and **Dr. Uttam Ghosh**, Assistant Professor, Department of Applied Mathematics, University of Calcutta, 92 APC Road, Kolkata700009 about Research Collaborations in four published research articles on Mathematical disease modelling.

Clauses of MOU

1) Both the signing parties will follow Research ethics. share ideas and will not show any conflict of interest while publishing any documents or research articles.
2) Both the parties will utilise Research Grants whatsoever from any source for the fulfilment of that project.

Time period of Collaboration
This collaborating MOU will remain in vogue until one of the signing parties wishes to withdraw himself from the MOU

Signed

1. First Party

Sudhanshu Kumar Biswas.

2. Second Party

Functionality of the MOU

Within the purview of the MOU signed between **Mr. Sudhanshu Kumar Biswas, Assistant Professor, Dept. of Mathematics, Sripat Shing College, Jiaganj, Murshidabad and Dr. Uttam Ghosh, Assistant Professor, Department of Applied Mathematics, University of Calcutta, 92 APC Road, Kolkata700009** the following outcomes were obtained:

Four publications in reputed International Journal including

1) **COVID-19 pandemic in India: a mathematical model study, Nonlinear Dynamics, 102: 537-553, 2020.**
2) **Mathematical modelling of COVID-19: A case study of Italy, Mathematics and Computer in Simulation, 194, 1-18, 2022.**
3) **An SEQAIHR model to study COVID-19 transmission and optimal control strategies in Hong Kong, 2022, Nonlinear Dynamics, 102: 537-553, 2020. 111, 6873-6893.**
4) **Effect of sexual and vertical transmission on Zika virus dynamics under environmental fluctuations, International Journal of Biomathematics, 2450019, DOI: S1793524524500190, 2024**

Signed: Dated the 21th March, 2020

Nonlinear Dyn (2020) 102:537–553
https://doi.org/10.1007/s11071-020-05958-z

ORIGINAL PAPER

COVID-19 pandemic in India: a mathematical model study

Sudhanshu Kumar Biswas · Jayanta Kumar Ghosh · Susmita Sarkar · Uttam Ghosh

Received: 12 July 2020 / Accepted: 14 September 2020 / Published online: 21 September 2020
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Abstract The present novel coronavirus (SARS-CoV-2) infection has created a global emergency situation by spreading all over the world in a large scale within very short time period. But there is no vaccine, anti-viral medicine for such infection. So at this moment, a major worldwide problem is that how we can control this pandemic. On the other hand, India is high population density country, where the coronavirus infection disease (COVID-19) has started from 1 March 2020. Due to high population density, human to human social contact rate is very high in India. So controlling pandemic COVID-19 in early stage is very urgent and challenging problem of India. Mathematical models are employed to study the disease dynamics, identify the influential parameters and access the proper prevention strategies for reduction outbreak size. In this work, we have formulated a deterministic compartmental model to study the spreading of COVID-19 and estimated the model parameters by fitting the model with reported data of ongoing pandemic in India. Sensitivity analysis has been done to identify the influential model parameters. The basic reproduction number has been estimated from actual data and the effective basic reproduction number has been studied on the basis of reported cases. Some effective preventive measures and their impact have also been studied. Prediction are given on the future trends of the virus transmission under some control measures. Finally, the positive measures to control the disease have been summarized in the conclusion section.

Keywords Basic reproduction number · COVID-19 · Asymptomatic class · Quarantine · Sensitivity analysis · Prevention measure

Mathematics Subject Classification 37N25 · 49J15 · 92D30

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Sripat Singh College, Murshidabad, West Bengal, India

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e-mail: uttam_math@yahoo.co.in

1 Introduction

The novel coronavirus disease (COVID-19) is a worldwide infectious disease in the current time [1–5]. Including this year pandemic, world faces severe attack by coronavirus several times, and some of those are SARS-CoV [6], MERS-CoV [7–10] and SARS-CoV-2 [11]. The symptom of all coronavirus patients is same; they suffer with respiratory problem, fever, dry cough, etc., but COVID-19 is more infectious compare to predecessors [11]. Most of the countries throughout the world are affected by this disease and its harmfulness is increasing day to day. The disease is spreading among different countries mainly through air-travel mode as large number of people is travelling from one country to another [12–14]. To control the disease spreading, WHO provided an advisory to all the counties regard-

ing screening of people at both ends: exit and the entry of country [2,15].

After 5 April 2020, every countries have been suffering seriously due to the corona infection. A large number of people is confirmed as COVID-19 positive as well as a large number of people is in quarantine and also in asymptomatic stage. The exposed and the asymptomatic persons are more harmful as a result a large number of people is being infected every day. The exposed class are being infectious at any time as its incubation period is 2–14 days [16]. On the other hand, the asymptomatic class is most dangerous compared to any other class because the asymptomatic period is on an average three days [13], because the asymptomatic persons are not showing the symptoms of the disease as a result the people interacting with them are not taking any care about the disease so COVID-19 is spreading rapidly among the people.

On the other hand due to large number of infected cases and limited medical capacity in maximum countries, the diagnosis test of the exposed, asymptomatic and quarantined classes for confirmation of COVID-19 infection is low. This fact also promotes the number of the infected population [17]. The harmfulness of COVID-19 is so high that upto 11 May 2020, nearly forty two lakh people have been infected; among them, 2,87,131 are dead [16]. As the disease is spreading through interaction and no proper medicine is available till now, so minimizing the social distance and interaction among the people is only way to minimize the spreading of disease. To maintain social distancing, the China Government adopted the lockdown policy and is able to control the spreading of the disease [17,18]. Following this policy, every country is adopting this policy except some countries.

In highly populated countries like India, Bangladesh, etc., a large number of people move from one place to another place due to job, also a large number of population came in these countries from the highly infected countries. So these countries have high chance of spreading this disease. To control and stop the movement of the population, the Government of India adopted lockdown policy for twenty one days in the first phase, which starts from 25 March 2020, and it also extended upto 17 May 2020.

The COVID-19 is highly infectious worldwide spreading life-threatening disease. But there is no particular vaccine, medicine or anti-viral therapy to protect or recover from this infection. So the present important issue throughout the World is protecting the human society from this infection. In this context, some preventive measures such as maintaining social distance, wearing masks, frequently washing the hands with soap and water, etc., can be employed to protect human from this infection. Among the COVID-19 preventives, maintaining social distance plays an crucial role to protect from the infection. Social distancing means keeping a safe space among the peoples who are not their house hold [19]. The measurement of this social distance should be at least six feet [19]. In real field, a portion of the population always maintain social distance to avoid infection in the endemic period due to their awareness. In order to study the impact of this important factor (social distance) on the disease dynamics, we have incorporated it in our model.

Our main goal of this work is to study the disease dynamics of COVID-2019 by studying a deterministic compartmental model for Indian scenario and access the preventive measures to control COVID-19 outbreak in India. Using the daily reported cases of India, we have estimated the model parameters, estimated the effective reproduction number and make some prediction about the prevalence of the disease.

Organization of the paper is as follows: In Sect. 2, we have formulated the model. Basic properties and the basic reproduction number are given in Sects. 3 and 4, respectively. In Sect. 5, we study the steady state analysis of the disease-free equilibrium point. Model fitting, parameter estimation, model validation and prediction are done in Sect. 6. Study of sensitivity analysis is done in Sect. 7. Computation of basic reproduction number from initial growth rate and effective reproduction number are described in Sect. 8. Some preventive measures are presented in Sect. 9. Finally, the concluding remarks are given in Sect. 10.

2 Model formulation

In this work, we shall study the transmission mechanism of COVID-19 using a deterministic compartmental model. In order to formulate the model mathematically, we have divided total population $N(t)$ into seven mutually exclusive compartments on the basis of their disease status namely: susceptible ($S(t)$), exposed ($E(t)$), asymptomatic infected ($A(t)$), symptomatic infected but not quarantined ($I(t)$), symptomatic and quarantined infected ($Q(t)$), hospitalised

and isolated infected ($H(t)$) and recovered ($R(t)$) population, so at any time t total population $N(t) = S(t) + E(t) + A(t) + I(t) + Q(t) + H(t) + R(t)$. A susceptible person may be infected by the close contact with a infected person. In general, the quarantined and isolated persons are unable to transmit the virus to other susceptible person, but practically we observe that many staffs of quarantine and isolation centres such as doctor, nurse and health staff have been infected by such persons. Let proportions q_1 and q_2 of quarantine and isolation individuals, respectively, obey the rules of quarantine and isolation centre properly. So that a proportions $(1-q_1)$ and $(1-q_2)$ of quarantine and isolation individuals, respectively, does not obey the rules of such centre properly and they are responsible to transmit the virus among the staff of such centre. So, after getting infection due to a individual from S-class with interaction of any individuals of classes A, I, Q, H move to the exposed class. Here, we consider the force of infection in the form $\lambda(S, E, A, I, Q, H, R) = \frac{\beta\{I + \rho A + (1-q_1)Q + (1-q_2)H\}}{N}$, β is the transmission rate of COVID-19 from symptomatic people and ρ is the ratio of the transmission rate of asymptomatic and symptomatic infected individuals. A proportion d of susceptible population maintains a safe distance from one another due to lockdown, personal awareness and different awareness programmes. We have considered the constant recruitment rate π in susceptible class and the natural death rate μ. Exposed individuals move to three different compartments: asymptomatic, symptomatic and quarantined symptomatic class separately at the rate $\sigma_a, \sigma_i, \sigma_q$, respectively. Infected and quarantined infected individuals have been detected and hospitalised at the rate η_i, η_q, respectively. Asymptomatic, symptomatic, quarantined, hospitalised individuals recover from the infection at a rate $\gamma_a, \gamma_i, \gamma_q$ and γ_h, respectively, and COVID-19-induced mortality rate is δ. Under the above conditions, the flow diagram of the COVID-19 transmission is given in Fig. 1.

Under the above conditions and flow diagram (Fig. 1), the transmission of the virus is governed by the following system of nonlinear ODE:

$$\begin{cases} \frac{dS}{dt} = \pi - (\lambda(S,E,A,I,Q,H,R)(1-d) + \mu)S \\ \frac{dE}{dt} = \lambda(S,E,A,I,Q,H,R)(1-d)S \\ \qquad - (\sigma_a + \sigma_i + \sigma_q + \mu)E \\ \frac{dA}{dt} = \sigma_a E - (\gamma_a + \mu)A \\ \frac{dI}{dt} = \sigma_i E - (\eta_i + \gamma_i + \mu + \delta)I \\ \frac{dQ}{dt} = \sigma_q E - (\eta_q + \gamma_q + \mu + \delta)Q \\ \frac{dH}{dt} = \eta_i I + \eta_q Q - (\gamma_h + \mu + \delta)H \\ \frac{dR}{dt} = \gamma_a A + \gamma_i I + \gamma_q Q + \gamma_h H - \mu R \end{cases} \tag{1}$$

with the initial conditions $S(0) > 0, E(0) \geq 0, A(0) \geq 0, I(0) > 0, Q(0) \geq 0, H(0) \geq 0, R(0) \geq 0$ and description of the state variables and the parameters used in the model are presented in Table 1.

3 Positivity and boundedness of solutions

In this section, we shall study the basic properties of the COVID-19 model (1). The model will be biologically meaningful if all the variables are non-negative for $t \geq 0$ in other words solution with non-negative initial conditions will remain non-negative for all time, which we shall study in the next lemma.

Lemma 1 *Let us suppose $F(t) = (S, E, A, I, Q, H, R)$ along with the initial conditions $F(0) \geq 0$ then the solution $F(t)$ of the COVID-19 model (1) are non-negative for all $t \geq 0$.*

Proof Suppose $t_1 = sup\{t > 0, F(t) > 0\}$, which is a positive quantity. Now, multiplying the first equation of (1) by its integrating factor $\exp\left\{\mu t + \int_0^t \lambda(\tau)d\tau\right\}$ and arranging the equation, we get

$$\frac{d}{dt}\left[S(t)\exp\left\{\mu t + \int_0^t \lambda(\tau)d\tau\right\}\right] = \pi\exp\left\{\mu t + \int_0^t \lambda(\tau)d\tau\right\}$$

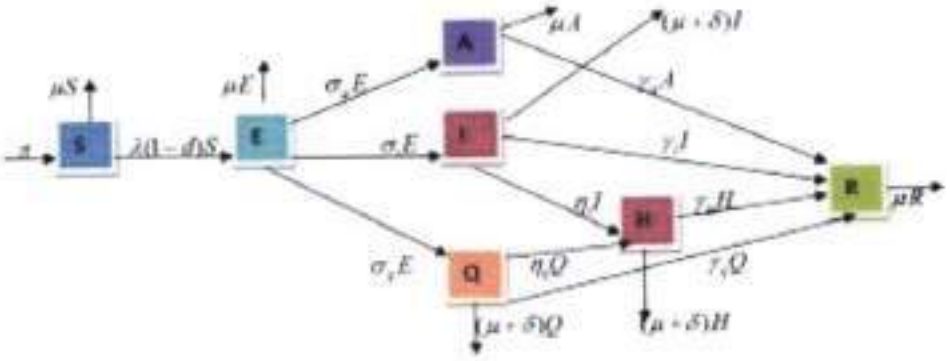

Fig. 1 Flow diagram of disease transmission of COVID-19

$$\text{or } S(t_1)\exp\left\{\mu t_1 + \int_0^{t_1}\lambda(\tau)\mathrm{d}\tau\right\} = S(0) + \pi\int_0^{t_1}\exp\left\{\mu y + \int_0^{y}\lambda(\tau)\mathrm{d}\tau\right\}\mathrm{d}y$$

$$\text{or, } S(t_1) = \left\{S(0) + \pi\int_0^{t_1}\exp\left\{\mu y + \int_0^{y}\lambda(\tau)\mathrm{d}\tau\right\}\mathrm{d}y\right\}\left\{\exp\left\{-\mu t_1 - \int_0^{t_1}\lambda(\tau)\mathrm{d}\tau\right\}\right\} > 0$$

$$\text{or, } S(t_1) = \left\{S(0) + \pi\int_0^{t_1}\exp\left\{\mu y + \int_0^{y}\lambda(\tau)\mathrm{d}\tau\right\}\mathrm{d}y\right\}\left\{\exp\left\{-\mu t_1 - \int_0^{t_1}\lambda(\tau)\mathrm{d}\tau\right\}\right\} > 0$$

Similarly, it can be established that $E(t_1) > 0$, $A(t_1) > 0$, $I(t_1) > 0$, $Q(t_1) > 0$, $H(t_1) > 0$, $R(t_1) > 0$. Thus, $F > 0$ for all $t > 0$. □

The dynamical nature of the COVID-19 model (1) shall be studied in the feasible closed region:

$$\Omega = \left\{(S, E, A, I, Q, H, R) \in \mathscr{R}_+^7 : S + E + A + I + Q + H + R \le \frac{\pi}{\mu}\right\}.$$

It will be established that the closed region Ω is a positively invariant and an attractor of all positive solutions of the COVID-19 model (1).

Lemma 2 *The closed region Ω is a positively invariant set for the COVID-19 model (1) with non-negative initial conditions in $\mathscr{R}_+^7$.*

Proof Adding all the seven component equations of the model (1) and using the relation $N = S + E + A + I + Q + H + R$, we have

$$\frac{\mathrm{d}N}{\mathrm{d}t} = \pi - \delta(I + Q + H) - \mu N \tag{2}$$

Using standard comparison theorem from [20], the following inequality can be solved as,

$$\frac{\mathrm{d}N}{\mathrm{d}t} \le \pi - \mu N$$

or,

$$\frac{\mathrm{d}N}{\mathrm{d}t} + \mu N \le \pi$$

or,

$$N(t) \le N(0)\mathrm{e}^{-\mu t} + \frac{\pi}{\mu}(1 - \mathrm{e}^{-\mu t}). \tag{3}$$

It is clear from (3) that $N(t) \le \frac{\pi}{\mu}$ if $N(0) \le \frac{\pi}{\mu}$. That is Ω is a positively invariant set under the flow presented in the COVID-19 model (1). Further, if $N(0) \ge \frac{\pi}{\mu}$, then $N(t)$ again approaches to $\frac{\pi}{\mu}$ and the number of infected population E, A, I, Q and H approach to zero for larger t. So all solutions in $\mathscr{R}_+^7$ of the model (1) eventually enters in Ω that is it is an attracting set. □

Thus, the COVID-19 model (1) is well-posed biologically and mathematically in the invariant set Ω [21].

4 Basic reproduction number

The basic reproduction number plays important role in controlling and spreading the disease. It is defined as the number of secondary infection, i.e. the number of new infection spread by a single infected person. Analytically, it can be found easily only when the disease-free equilibrium of the system exists. Hetchote [21], Diekmann et al. [22] and van den

Table 1 Interpretations of the model parameters

State variables/parameters	Biological meaning
$S(t)$	Abundance of susceptible population at time t
$E(t)$	Abundance of exposed population at time t
$A(t)$	Abundance of asymptomatic infected population at time t
$I(t)$	Abundance of symptomatic infected population but not quarantined at time t
$Q(t)$	Abundance of symptomatic infected population and quarantined at time t
$H(t)$	Abundance of hospitalised and isolated infected population at time t
$R(t)$	Abundance of recovered population at time t
d $(0 \le d \le 1)$	Proportion of susceptible population who obey lockdown strictly
q_1, q_2 $(0 \le q_1, q_2 \le 1)$	Proportion of quarantine and isolation effect on effective contact rate, respectively
ρ	Ratio of the virus transmission rate to infected population
β	Virus transmission rate from symptomatic infected to susceptible population
$\sigma_a, \sigma_i, \sigma_q$	Rate of conversion from exposed to A, I and Q, respectively
η_i, η_q	Rates of hospitalisation from symptomatic and quarantined infected populations, respectively
$\gamma_a, \gamma_i, \gamma_q, \gamma_h$	Recovery rates from asymptomatic, symptomatic, quarantined and hospitalised infected populations, respectively
π	Recruitment rate of human
μ, δ	Normal and disease-induced death rate of human, respectively

Driessche and Watmough [23] proposed a generalized approach to determine the basic reproduction number which is known as the next generation matrix approach. For the system (1), the disease-free equilibrium point is $E_0(\frac{\pi}{\mu}, 0, 0, 0, 0, 0, 0)$ and hence basic reproduction number of the proposed problem exists.

Here, we decompose the right hand side of the system (1) corresponding to the infected compartments E, A, I, Q, H as $\mathcal{F} - \mathcal{V}$, where

$$\mathcal{F} = \begin{pmatrix} \frac{\beta(\rho A + I + q_1 Q + q_2 H)(1-d)S}{N} \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \text{ and}$$

$$\mathcal{V} = \begin{pmatrix} k_1 E \\ -(\sigma_a E - k_2 A) \\ -(-k_3 I + \sigma_i E) \\ -(-k_4 Q + \sigma_q E) \\ -(-k_5 H + \eta_i I + \eta_q Q) \end{pmatrix} \text{ where } k_1 = \sigma_a + \sigma_i + \sigma_q + \mu, k_2 = \gamma_a + \mu, k_3 = \eta_i + \gamma_i + \mu + \delta, k_4 = \eta_q + \gamma_q + \delta + \mu, k_5 = \gamma_h + \delta + \mu.$$

Let us define

$$F = \frac{\partial \mathcal{F}}{\partial x_j}(E_0) = \begin{pmatrix} 0 & \beta\rho(1-d) & \beta(1-d) & \beta(1-q_1)(1-d) & \beta(1-q_2)(1-d) \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

and

$$V = \frac{\partial \mathcal{V}}{\partial x_j}(E_0) = \begin{pmatrix} -k_1 & \beta q_1(1-d) & \beta(1-d) & \beta\rho(1-d) & \beta_2(1-d) \\ \sigma_a & 0 & 0 & -\alpha & 0 \\ \sigma_i & 0 & -k_3 & 0 & 0 \\ \sigma_q & -k_4 & 0 & 0 & 0 \\ 0 & \eta_q & \eta_i & 0 & -k_5 \end{pmatrix},$$

for $x_j = E, A, I, Q, H$. Since the basic reproduction number is the spectral radius of the next generation matrix FV^{-1}. Hence, we have the basic reproduction number for the considered model is

$$\begin{aligned} R_0 &= \frac{\beta\rho(1-d)\sigma_a}{k_1 k_2} + \frac{\beta(1-d)\sigma_i}{k_1 k_3} + \frac{\beta(1-q_1)\sigma_q(1-d)}{k_1 k_4} \\ &\quad + \frac{\beta(1-q_2)(\eta_i k_4 \sigma_i + \eta_q k_3 \sigma_q)(1-d)}{k_1 k_3 k_4 k_5} \\ &= R_{0A} + R_{0I} + R_{0Q} + R_{0H} \end{aligned} \tag{4}$$

where R_{0A}, R_{0I}, R_{0Q} and R_{0H} are the parts of basic reproduction number contributed by asymptomatic infected class, symptomatic but non-quarantined infected class, symptomatic and quarantined infected class and hospitalised infected class, respectively.

5 Steady state analysis

In this section, we shall study the stability analysis of the disease-free equilibrium point $E_0(\frac{\pi}{\mu}, 0, 0, 0, 0, 0, 0)$ whose stability has been investigated in the next theorem.

Theorem 1 *If $R_0 > 1$, then the DFE E_0 is unstable and it is stable if $R_0 < 1$.*

Proof : The variational matrix corresponding to the system (1) at DFE $E_0(\pi/\mu, 0, 0, 0, 0, 0, 0)$ is

$$J(E_0) = \begin{pmatrix} -\mu & 0 & -\beta\rho(1-d) & -\beta(1-d) & -\beta(1-q_1)(1-d) & -\beta(1-q_2)(1-d) & 0 \\ 0 & -k_1 & \beta\rho(1-d) & \beta(1-d) & \beta(1-q_1)(1-d) & \beta(1-q_2)(1-d) & 0 \\ 0 & \sigma_a & -k_2 & 0 & 0 & 0 & 0 \\ 0 & \sigma_i & 0 & -k_3 & 0 & 0 & 0 \\ 0 & \sigma_q & 0 & 0 & -k_4 & 0 & 0 \\ 0 & 0 & 0 & \eta_i & \eta_q & -k_5 & 0 \\ 0 & 0 & \gamma_a & \gamma_i & \gamma_q & \gamma_h & -\mu \end{pmatrix}.$$

The eigenvalues of the variational matrix $J(E_0)$ are $-\mu, -\mu, \lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$, where $\lambda_i (i = 1, 2, 3, 4, 5)$ are the roots of the following equation:

$$P(\lambda) = \frac{\sigma_a\beta\rho(1-d)}{(k_1+\lambda)(k_2+\lambda)} + \frac{\sigma_i\beta(1-d)}{(k_1+\lambda)(k_3+\lambda)} + \frac{\sigma_q\beta(1-d)(1-q_1)}{(k_1+\lambda)(k_4+\lambda)} + \frac{\eta_q\sigma_q\beta(1-d)(1-q_2)}{(k_1+\lambda)(k_4+\lambda)(k_5+\lambda)} + \frac{\eta_i\sigma_i\beta(1-d)(1-q_2)}{(k_1+\lambda)(k_3+\lambda)(k_5+\lambda)} - 1 = 0.$$

Then, $P(0) = R_0 - 1$. There are two cases.

Case I Suppose $R_0 > 1$. Then, $P(0) > 0$. Again, $P(\lambda)$ tends to -1 as λ tends to ∞. Since $P(\lambda)$ is a continuous function of λ, hence the Bolzano theorem on continuous function implies that $P(\lambda_i) = 0$ for some $\lambda_i > 0$. Thus, at least one eigenvalue of the variational matrix must be positive. Therefore, in this case the DFE E_0 is unstable.

Case II Suppose $R_0 < 1$. Then, $P(0) < 0$.

If possible let us assume that $P(\lambda) = 0$ has a root of the form $x + iy$, where $x, y \in \mathbb{R}$ and $x \geq 0$. Then, $P(x + iy) = 0$.

Again, $|P(x+iy)+1| \leq \frac{\sigma_a\beta\rho(1-d)}{|k_1+\lambda||k_2+\lambda|} + \frac{\sigma_i\beta(1-d)}{|k_1+\lambda||k_3+\lambda|} + \frac{\sigma_q\beta(1-d)(1-q_1)}{|k_1+\lambda||k_4+\lambda|} + \frac{\eta_q\sigma_q\beta(1-d)(1-q_2)}{|k_1+\lambda||k_4+\lambda||k_5+\lambda|} + \frac{\eta_i\sigma_i\beta(1-d)(1-q_2)}{|k_1+\lambda||k_3+\lambda||k_5+\lambda|}$

$\leq \frac{\sigma_a\beta\rho(1-d)}{(k_1+x)(k_2+x)} + \frac{\sigma_i\beta(1-d)}{(k_1+x)(k_3+x)} + \frac{\sigma_q\beta(1-d)(1-q_1)}{(k_1+x)(k_4+x)} + \frac{\eta_q\sigma_q\beta(1-d)(1-q_2)}{(k_1+x)(k_4+x)(k_5+x)} + \frac{\eta_i\sigma_i\beta(1-d)(1-q_2)}{(k_1+x)(k_3+x)(k_5+x)} \leq \frac{\sigma_a\beta\rho(1-d)}{k_1k_2} + \frac{\sigma_i\beta(1-d)}{k_1k_3} + \frac{\sigma_q\beta(1-d)(1-q_1)}{k_1k_4} + \frac{\eta_q\sigma_q\beta(1-d)(1-q_2)}{k_1k_4k_5} + \frac{\eta_i\sigma_i\beta(1-d)(1-q_2)}{k_1k_3k_5} = R_0 < 1$, which implies that $1 < 1$. This is clearly a contradiction. Hence, all the roots of the equation $P(\lambda) = 0$ have the form $x + iy$, where $x, y \in \mathbb{R}$ and $x < 0$. Thus, in this case the DFE is stable.

Hence, the theorem is proved. □

6 Model fitting-parameter estimation and model validation

In this section, we shall estimate the model parameters using COVID-19 reported real data. It has been spread all over the World at a high alarming rate. So the control of the transmission of this virus as early as possible is very essential for the existence of human civilization. On the other hand, the natural history and dynamics of the novel coronavirus is unknown till date. In this context, parameter estimation is an important task to study its dynamics.

6.1 Model fitting and parameter estimation

We have estimated the key model parameters connected to COVID-2019 by fitting the reported cases of the ongoing COVID-19 pandemic in India. Although this data set is incomplete as the pandemic is ongoing, but we shall use it for controlling this pandemic after studying its early dynamics. Actually, the COVID-19 outbreak starts in India from 1 March 2020, as from that date the new infected cases are reported continuously. On the other hand, a major preventive measure was taken by the Government of India by implementing a countrywide lockdown from 25 March 2020 and which has been continuing upto 17 May 2020 and

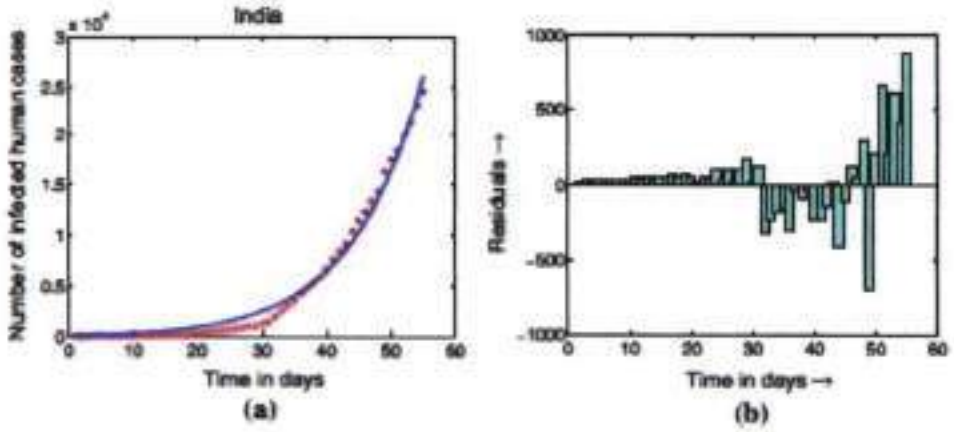

Fig. 2 **a** Model simulation to the cumulative reported cases from 1 March to 24 April 2020 in India, the red dots denote the reported infected cases and blue line presents the model predicted infected cases **b** Residuals of the corresponding data fitting

may continue further if necessary. So we consider two sets of data: first one (set-1) is the collection of the cases reported during the period 1 March to 24 April of 2020. But before the implementation of lockdown (25 March 2020) many, exposed, symptomatic as well as asymptomatic infected person come in India from other COVID-19 pandemic countries, who are neither detected nor reported properly. So there remain uncertainty among the data reported during the period 1 March to 24 March 2020. Thus, we consider the second set (set-2) of data reported during the period 25 March to 24 April 2020 by avoiding the data reported in above said period. We have fitted the model to both the sets of data. The fitting to the first set is presented in Fig. 2a, b, and the estimated parameters are summarised in Table 2, whereas the fitting of the second set is presented in Fig. 3a, b, and the corresponding parameters are put in Table 3. The results show that the second one is best fit and we shall use this set for model prediction.

We have fitted the model to cumulative cases of India, which are obtained from [16]. Our model predicted cumulative new infected cases ($q(t)$) satisfy the following equation:

$$q(t,\Phi) = q(0) + \int_0^t (\eta_I I(\tau) + \eta_q Q(\tau))\mathrm{d}\tau \qquad (5)$$

We solve the model equations numerically and use the solutions to determine the best-fit model parameters by using a nonlinear least squares regression technique which minimizes the sum of the squared residuals:

$$R(\Phi) = \sum_{j=1}^{n} \left(q_{t_j}(\Phi) - \overline{q}_{t_j}\right)^2$$

where $\Phi = (\beta, \sigma_a, \sigma_i, \sigma_q, \gamma_a, \gamma_i, \gamma_q, \gamma_h, \eta_i, \eta_q, \delta, \rho, d)$ is a set of model parameters to be estimated. $q_{t_j}(\Phi)$ and $\overline{q}_{t_j}$ are cumulative number of infected population accordingly by model prediction and by reported data, respectively. Here, n denotes the total number of data points available for the fitting process.

In order to fit the model with the reported cases of India, we have total population in India is 1,352,642,280 [24] considered as susceptible for COVID-19 that the initial number of susceptible $S(0) = 1,352,642,280$. The birth rate is 18.2/1000 per year [24]. So the daily recruitment rate in India is 67,446.82. The average life span of India is 69.7 [24] years, and hence, the death rate is 0.000039074.

For the first data set initially that is on the 1 March 2020 the reported cumulative infected cases were 3, which number of cases has been considered as initial hospitalise cases and initial cumulative cases that is $H(0) = 3$ and $q(0) = 3$. There are no available information about the initial number of exposed, asymptomatic infected and symptomatic but non-quarantined (that is non-reported) infected which are estimated that is $E(0)$, $A(0)$, $I(0)$ are estimated for the both data set and assume that $q_1 = 0.94, q_2 = 0.90$. Using the above initial conditions, recruitment rate and normal death rate, we have fitted our model (Fig. 2a) with the reported data [16] whose corresponding residuals are presented in Fig. 2b, and we have estimated all other key parameters including the basic reproduction number. According to our estimation, $E(0) = 111$, $A(0) = 16$, $I(0) = 10$ and the value of the basic reproduction is $R_0 = 2.397448679$ among which the contribution of the asymptomatic infected class is $R_{0A} = 1.317554127$. Similarly, the contribution of the symptomatic but non-quarantined infected class,

Table 2 List of the model parameters and their sensitivity indices for COVID-19 pandemic in India, estimated from the data from 1st March to 24th April 2020

Parameters	Values	Source	Sensitivity indices
π	67446.82054 day^{-1}	[16]	–
μ	0.0000391 day^{-1}	[16]	−0.00076
β	1.11525 day^{-1}	Estimated	1.000000000
α_a	0.08275 day^{-1}	Estimated	0.44301
α_i	0.35872 day^{-1}	Estimated	−0.08026
α_q	0.33511 day^{-1}	Estimated	−0.36270
γ_a	0.03435 day^{-1}	Estimated	−0.54894
γ_i	0.01496 day^{-1}	Estimated	−0.01794
γ_q	0.05481 day^{-1}	Estimated	−0.00619
γ_h	0.09310 day^{-1}	Estimated	−0.08415
η_i	0.26190 day^{-1}	Estimated	−0.25181
η_q	0.51323 day^{-1}	Estimated	0.00152
δ	0.04142 day^{-1}	Estimated	−0.09177
q_1	0.94	Assumed	−0.14651
q_2	0.90	Assumed	−1.09464
ρ	0.80576	Estimated	0.54957
d	0.52674	Estimated	−1.11299
R_0	2.39745	Estimated	1.00000

Table 3 List of the model parameters and their sensitivity indices for COVID-19 pandemic in India estimated from the data from 25 March to 24 April 2020

Parameters	Values	Source	Sensitivity indices
π	67446.82054 day^{-1}	[16]	–
μ	0.0000391 day^{-1}	[16]	−0.00065
β	0.88689 day^{-1}	Estimated	1.0000
α_a	0.24176 day^{-1}	Estimated	0.44295
α_i	0.24757 day^{-1}	Estimated	−0.13547
α_q	0.26556 day^{-1}	Estimated	−0.30743
γ_a	0.05311 day^{-1}	Estimated	−0.76262
γ_i	0.05090 day^{-1}	Estimated	−0.02561
γ_q	0.05071 day^{-1}	Estimated	−0.00435
γ_h	0.07048 day^{-1}	Estimated	−0.03394
η_i	0.26267 day^{-1}	Estimated	−0.10165
η_q	0.39787 day^{-1}	Estimated	0.00255
δ	0.06891 day^{-1}	Estimated	−0.07377
q_1	0.94	Assumed	−0.12070
q_2	0.90	Assumed	−0.60436
ρ	0.67047	Estimated	0.76318
d	0.48576	Estimated	−0.94461
R_0	2.41419	Estimated	1.00000

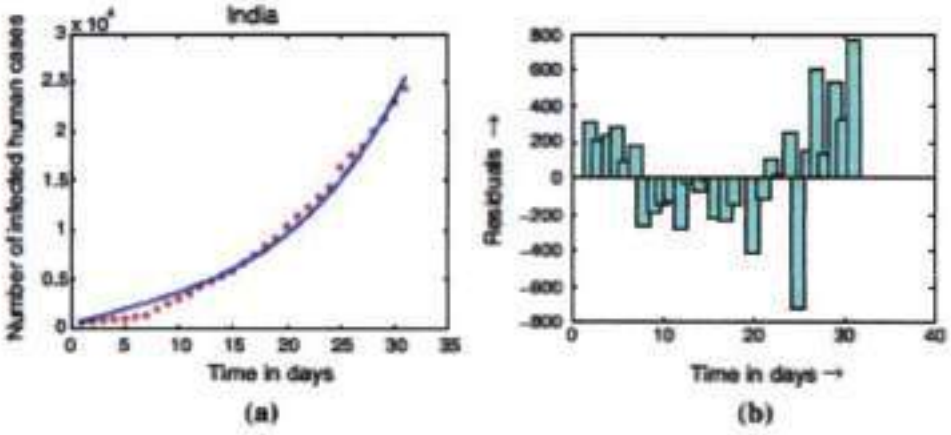

Fig. 3 **a** Model simulation to the cumulative reported cases from 25 March to 24 April 2020 in India, the red dots denote the reported infected cases and blue line presents the model predicted infected cases **b** Residuals of the corresponding data fitting

symptomatic and quarantined infected class and hospitalised infected class are $R_{0I} = 0.7658798290$, $R_{0Q} = 0.02241962187$, $R_{0H} = 0.2915951005$, respectively. As the contribution of the asymptomatic infected class (R_{0A}) is larger in comparison with the other part, so we have to focus on the reduction in R_{0A} in a prevention strategies, which will be discussed in detail in prevention section.

For the second data set initially that is on date 25 March, cumulative number of infected population $q(0) = 657$, $H(0) = 657$, $S(0) = 1352642280$ and we assume $Q(0) = 647$, the other initial conditions, i.e. $E(0)$, $A(0)$, $I(0)$ are estimated. Under the above initial condition, the model fitting with the second set of data is presented in Fig. 3a and the corresponding residuals are presented in Fig. 3b. According to our estimation, $E(0) = 1131$, $A(0) = 506$, $I(0) = 482$ and the basic reproduction is $R_0 = 2.414190966$ among which the contributions of different infected classes are $R_{0A} = 1.842473415$, $R_{0I} = 0.3910030945$, $R_{0Q} = 0.01860012179$, $R_{0H} = 0.1621143316$. In both Figs. 2a, b and 3a, b, we have presented the cumulative number of real cases and the model predicted case and residual plot for the data set-1 and set-2, respectively. The randomness in the residue for both cases suggest that the fitness is good for each case.

6.2 Model validation and prediction

In this part, we validate the model by comparing the model predictions with the reported data which are not used for fitting process using both sets of parameters. We have compared the model predicted daily cases with the reported daily cases with the help of a bar diagram of daily cases reported in India from 25 April to 10 May 2020 with the model predicted daily cases. The model predicted cases estimated from first set of parameters are given in Fig. 4a, whereas the prediction estimated from second set of parameters is given in Fig. 4b. Here, the blue colour bar denotes predicted daily new cases and red colour bar denotes reported cases. From Fig. 4a and b, it is clear that the second one gives more perfect estimation compared to the first one.

The best estimator also can be justified from the standard error of the two cases. The standard error corresponding to the model fitting to the first set of parameters is 2.8264954×10^7, and the error for the fitting to the second set is 1.630582×10^7. So the second set is the best fitting compared to the first set. Secondly, many exposed, asymptomatic infected, symptomatic infected persons came to India before on 25 March 2020 (before the lockdown) from other COVID-19 affected countries which are not detected properly. So there is uncertainty in reported data before 25 March 2020. So, we are not considering the data which reported before on that date. Thirdly from Fig. 4a and b, it is clear that the prediction based on second set of parameters is more perfect compared to the first one. For the above said reason, we shall choose the second set of parametric values which are estimated from the data reported from 25 March to 24 April 2020 to study the future trend of the outbreak and for model prediction.

In order to study the future trend of outbreak and predict from the model, we find the time series for the cumulative infected number of population in Fig. 5a and for different infected classes in Fig. 5b using the same initial conditions used in data fitting process and

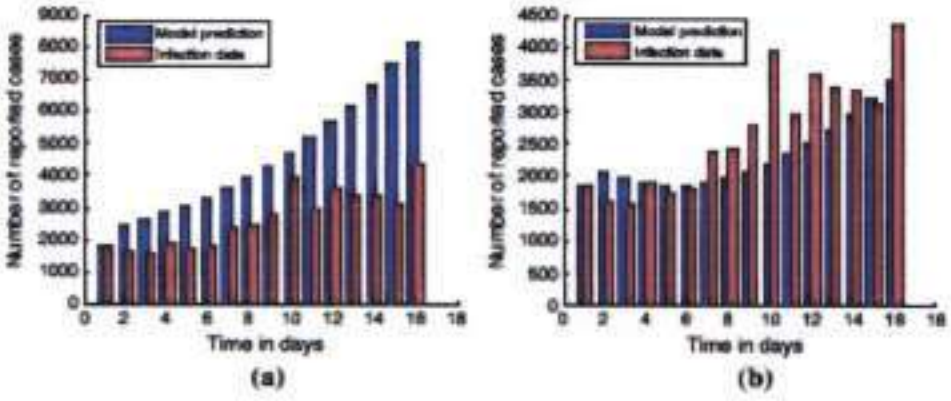

Fig. 4 Bar diagram of the daily infected cases where red bar denotes the reported case and blue bar denotes the model predicted case from **a** set-1 parameter values **b** set-2 parameter values, for 25th April to 10th May 2020

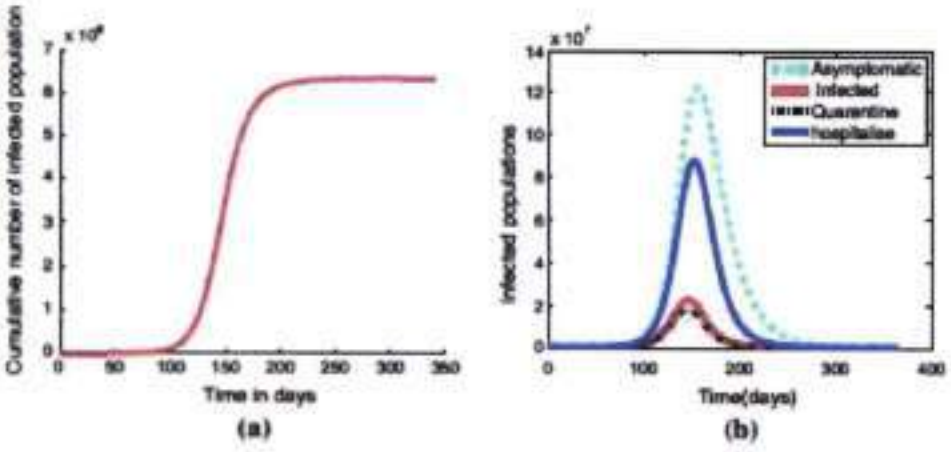

Fig. 5 Time series for the **a** cumulative number of infected population and **b** different infected population using the estimated parametric values and same initial condition

estimated parameter values for one year that is for 365 days from 25 March 2020. From Fig. 5a, it is clear that at that time total number of infected population will be 6.345×10^8. Fig. 5b indicates that the number of symptomatic infected population will be maximum on around 146th day starting from 25 March 2020, i.e. on around 17 August 2020, the hospitalised case will be maximum on around 23 August 2020 and the asymptomatic case will be maximum on 27 August 2020. The model also predicts that the disease will be fully controlled after 365 days.

7 Sensitivity analysis

Novel coronavirus has been spreading globally at a high alarming rate, and it is a threat for human civilization. So prevention and control of this viral disease is very important task at this moment. In this context, first of all we have to identify and quantify the influential model parameters. In order to determine such parameters, we shall estimate sensitivity index of the basic reproduction number with respect to different parameters. Using the normalized forward sensitivity method [25,26], we have obtained sensitivity index $S_\alpha = \frac{\partial R_0}{\partial \alpha}\frac{\alpha}{R_0}$, where α is the characteristic parameter whose sensitivity on R_0 has to be determined. The calculated sensitivity indices with respect to each of the model parameters using both sets of parametric values have been presented in the last column of Tables 2 and 3, respectively. The significance of this index is that the index with higher in magnitude is more sensitive parameter on R_0. The significance of the positive (or negative) sign of the sensitivity index is that R_0 increases (or decreases) as the parameter α increases. Our findings show that the most influential parameters are lockdown factor (d), virus transmission rate (β), ratio of the virus transmission rate of asymptomatic and symptomatic infected population (ρ), recovery rate from asymptomatic infection class (γ_a), disease-induced death rate (δ), transmission rate from exposed to asymptomatic infection class (σ_a) and recovery rate from hospitalised infected class (γ_h). Such indices can be guided to identify and quantify the effective control and prevention strategies.

8 Basic reproduction number of the COVID-19 outbreak in India

In this section, we shall estimate the basic reproduction number from the actual data and study the effective basic reproduction number for the outbreak in India.

$$\begin{cases} (\Lambda + k_1)E_0 = \beta(1-d)\{I_0 + \rho A_0 \\ \qquad\qquad +(1-q_1)Q_0 + (1-q_2)H_0\} \\ (\Lambda + k_2)A_0 = \sigma_a E_0 \\ (\Lambda + k_3)I_0 = \sigma_i E_0 \\ (\Lambda + k_4)Q_0 = \sigma_q E_0 \\ (\Lambda + k_5)H_0 = \eta_i I_0 + \eta_q Q_0 \end{cases} \tag{7}$$

Using the Eq. (7) in the expression R_0 given in (4), we have the following relation between the basic reproduction number (R_0) and the force of infection (Λ)

$$R_0 = \frac{\Lambda + k_1}{k_1} \frac{\frac{\sigma_i}{k_3} + \frac{\rho\sigma_a}{k_2} + \frac{(1-q_1)\sigma_q}{k_4} + \frac{(1-q_2)(\eta_i k_4\sigma_i + \eta_q k_3\sigma_q)}{k_3k_4k_5}}{\frac{\sigma_i}{\Lambda+k_3} + \frac{\rho\sigma_a}{\Lambda+k_2} + \frac{(1-q_1)\sigma_q}{\Lambda+k_4} + \frac{(1-q_2)}{(\Lambda+k_5)}\left(\frac{\eta_i\sigma_i}{\Lambda+k_3} + \frac{\eta_q\sigma_q}{\Lambda+k_4}\right)} \tag{8}$$

8.1 Estimation of R_0 from actual data of COVID-19 outbreak in India

There are several mathematical as well as statistical techniques to compute the basic reproduction number (R_0) for infectious diseases from the actual pandemic data [27]. In this section, we estimate the basic reproduction number R_0 from initial growth phase of the COVID-19 epidemic in India [28]. We assume that at the early stage of pandemic the cumulative number of cases $q(t)$ varies as $\exp(\Lambda t)$ [29], i.e. $q(t) \propto \exp(\Lambda t)$ where Λ is the force of infection. Similarly, the number of exposed, asymptomatic, symptomatic but non-quarantined, symptomatic and quarantined, hospitalised infected population varies with $\exp(\Lambda t)$. So we have

$$\begin{cases} E \sim E_0 \exp(\Lambda t) \\ A \sim A_0 \exp(\Lambda t) \\ I \sim I_0 \exp(\Lambda t) \\ Q \sim Q_0 \exp(\Lambda t) \\ H \sim H_0 \exp(\Lambda t) \end{cases} \tag{6}$$

where E_0, A_0, I_0, Q_0 and H_0 are constant. Again, we assume that the number of non-susceptible population for COVID-19 in India be negligible, i.e. $S(t) = \pi/\mu$. Now, substituting (6) into the model equation (1), we have:

In order to estimate the basic reproduction number R_0 from the expression (8), we have to estimate the force of infection Λ and the estimated others parameter are given in Table 2. According to [29], the daily number of new cases and the number of cumulative cases $q(t)$ connected by the relation: the daily number of new cases $\sim \Lambda q(t)$. So we estimate Λ by plotting the number of daily new cases verses the number of cumulative cases $q(t)$, the phase of exponential growth of the cumulative number of cases is evidenced by a linear growth of the curve the slope of which is the force of infection (Λ). This linear growth of the curve computes by a least-square linear fit [29]. For the reported data from 1 March to 24 April 2020, COVID-19 outbreak in India presents in Fig. 6a. Now, on the basis of the slope of the line presents in Fig. 6b we have $\Lambda = 0.0699294352820240.0074272618075 10$ day^{-1}. Using the expression (7) along with the above estimated Λ and other parameter presented in Table 2, we have the estimate $R_0 = 2.095744073$ with lower and upper values are 1.990274890 and 2.200561243, respectively.

8.2 Effective reproduction number

We know that the basic reproduction number plays important role in controlling the disease spreading. It is the average number of secondary infection during the infection period. Since when $R_0 < 1$, then the average

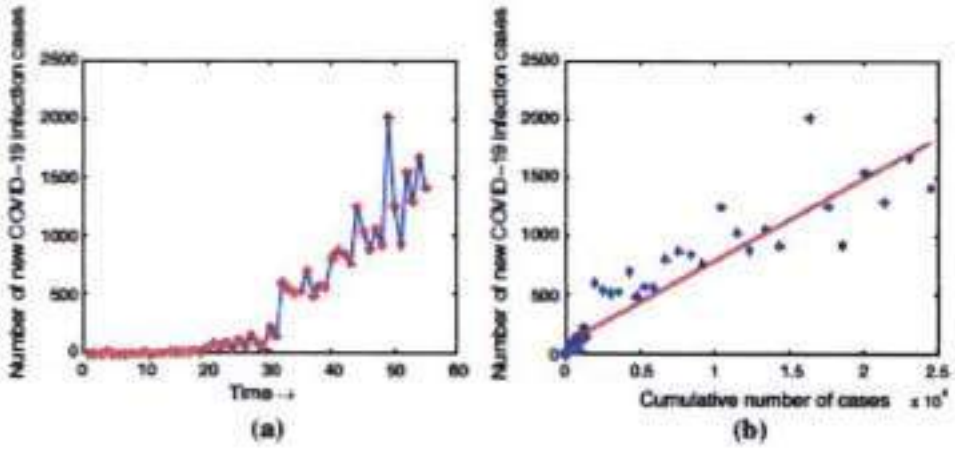

Fig. 6 (a) The time series of new cases of COVID-19 and (b) the daily number of cases against the cumulative number of cases

number of secondary infection in the infection period is less than one and consequently the disease is easy to control. But as the number of secondary infection is changing time to time for COVID-19 infection persons. As a result to control number of secondary infection consequently the reproduction number for each day.

In this section, we shall describe the effective reproduction number is denoted by $R(t)$ and defined as the number of secondary infections affected by a single primary infection at the tth day. Then, the quantity $R(t)$ will give the information about the necessary steps to control the COVID-19 in India. The estimation of $R(t)$ can be done using the following renewal equation [30–32]

$$R(t) = \frac{b(t)}{\int_{\tau=0}^{\infty} b(t-\tau)h(\tau)\mathrm{d}\tau}$$

where $b(t)$ is the number of new cases at tth day and $h(\tau)$ is the generation interval distribution for the COVID-19 disease. It is the probability distribution function of time from infection of a person to the secondary infection case by that person. Let the leaving rate of the infected class from the corresponding compartments are $m_1 = \sigma_a + \sigma_i + \sigma_q + \mu$, $m_2 = \gamma_a + \mu$, $m_3 = \eta_i + \gamma_i + \mu + \delta$, $m_4 = \eta_q + \gamma_q + \mu + \delta$ and $m_5 = \gamma_h + \mu + \delta$. Therefore, the function will be combination of the five exponential functions $m_1 e^{-m_1 t}, m_2 e^{-m_2 t}, m_3 e^{-m_3 t}, m_4 e^{-m_4 t}$ and $m_5 e^{-m_5 t}$ in the following form

$$h(t) = \sum_{i=1}^{5} \frac{m_1 m_2 m_3 m_4 m_5 e^{-m_i t}}{\prod_{j=1 j\neq i}^{5}(m_j - m_i)}$$

with mean of the distribution is $T = \frac{1}{m_1} + \frac{1}{m_2} + \frac{1}{m_3} + \frac{1}{m_4} + \frac{1}{m_5}$ and $\tau > 0$. The above relation is valid when the force of infection $\zeta > \min\{-m_1, -m_2, -m_3, -m_4, -m_5\}$. Using the model estimated parameters, we have calculated the effective reproduction numbers and presented them in Fig. 7. It is clear from the figure that the effective reproduction number oscillate, but its value is above two upto the considered date except one day. To control the disease, we have to decrease its value lower than one.

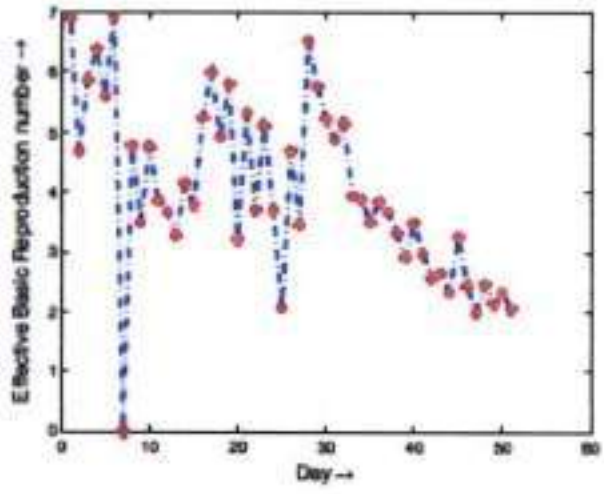

Fig. 7 Effective reproduction number

9 Model prediction and some preventive measures

In this part, we shall explore the model prediction in Indian aspect and seek the preventive measure to control COVID-19 in India. The model parameter d denotes the proportion of population who maintain the social distance from other (or stay at home in safe). According to our estimation, 67.38% of the population

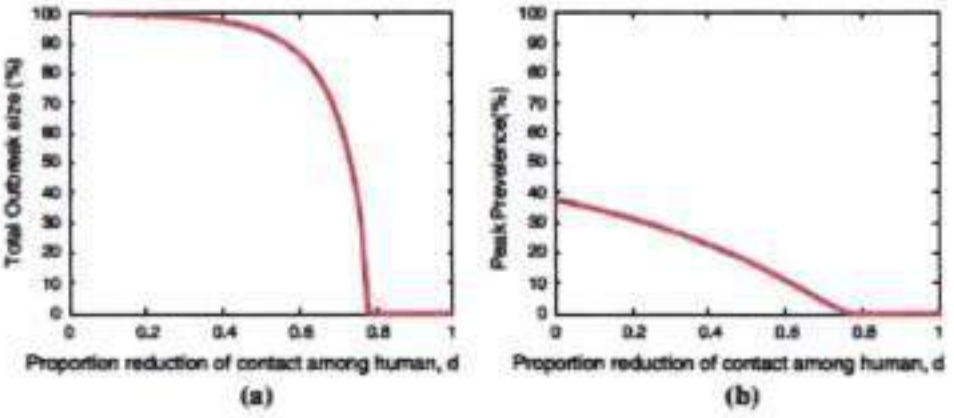

Fig. 8 a Total outbreak size and b Peak prevalence during the pandemic predicted by the model for the prevention programs on reducing proportion of social distance among human

maintain the social distance from other people in the lockdown period.

In Fig. 8, we presented the model predicted total out break size and the peak prevalence during the pandemic varying the value of d for the entire time period of prevalence. It is clear from the figures that if 80% people follow the lockdown Model effect, the disease is easy to control. Thus, to control the disease the administration should be strict to impose the lockdown properly. Since, as per our model prediction only 20% or less people does not follow the lockdown then disease may be controlled. So only the administrative, food and medicine supply persons may go outside breaking the lockdown.

9.1 Programme for maintain safe distance among human and successful lockdown

(i) A part of population maintain social distance or safe distance from each other to protect the virus transmission. In the model, this part or fraction is denoted by the parameter d. In order to find the possible impact of the parameter d on the total outbreak and peak prevalence, we have plotted total outbreak with respect to d in Fig. 8a and the peak prevalence with respect to d in Fig. 8b. According to our model, the total outbreak size ($q(t, \Phi)$) is given in the relation 5.

Our finding shows that due to increasing of d (proportion of population who maintain social distance) upto 0.77 the total outbreak size reduces from 100% to 13% (Fig. 8a) and the peak prevalence reduces from 37.77 to 0.28%, i.e. at a negligible level (Fig. 8b). The parameter d can be increased by awareness programme through public media like T.V. programme, mobile message or broadcasting through any local media. The information regarding the infection like number of infected population number of COVID-19-related death in the local area should be provide in proper time regularly and repeatedly. Such information will increase the consciousness of the people in the affected area and they maintained the social distance from each other and increased the value of d. On the other hand, the wrong information can misguide the people and they do not maintain the safe distance from each other as a result d will be decreased.

India is a high population density country. Many people gather in market, ration shop to collect different food item, and they do not maintain minimum distance from each other as a result d decreases. In order to solve this problem, self-help group can be used for home delivery of different food item and other necessary requirements instead of cost or without cost (for poor citizen). Formation of self-help group and their instant training in each local area can be done with the help of local government like as panchayat, municipality corporation, etc. In this way, the supply of necessary requirements can be done in a systematic way and the parameter d can be decreased in a significant amount even after lockdown period.

Another notable factor is that a major portion Indian use the public vehicles like train, bus and air transport. It is impossible to maintain safe distance among such vehicles passengers and the parameter d will decrease. A susceptible man may be infected by an infectious person when they travel using same vehicle without maintaining the safe distance. In this way, the virus infection spread from infected area to uninfected area. So our proposal is that the pub-

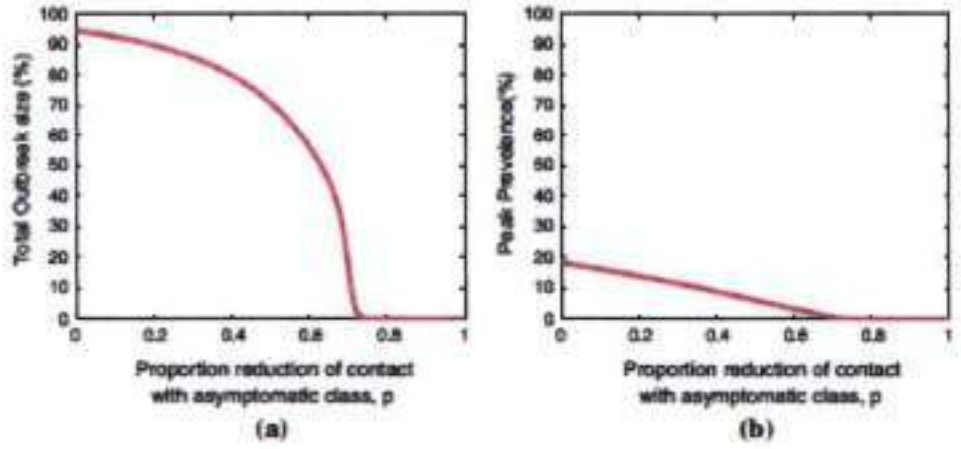

Fig. 9 a Total outbreak size and b Peak prevalence during the pandemic predicted by the model for the prevention programs on reducing proportion of social distance among human

lic vehicles should be closed in entire pandemic period.

9.2 Prevention measure on asymptomatic class

Due to high population density, in general human to human contact rate is high in India. On the other hand, an asymptomatic infected human has no symptom, but he/ she is able to transmit the virus to other susceptible human. So susceptible person will not take or take in late (after diagnostic test) prevention measure to protect from the virus transmission from an asymptomatic infected person. In this context, our finding shows that approximately 45% of the infected population are asymptomatic. The time series of different infected populations (see Fig. 5b) show that the number of daily asymptomatic infected population is larger than other infected population. The contribution on basic reproduction number of asymptomatic infected class is larger than other compartment. So protection of the virus transmission from asymptomatic infected class is a challenging problem for India like highly populated country.

In order to solve this problem, we propose a prevention policy that reduces contact rate between asymptomatic infected human and susceptible human. In this context, first of all we have to identify the asymptomatic infected human among the population and then keep them in quarantine. To identify asymptomatic infected human, we have to focus on the diagnostic test among major portion of population, specially in the affected area and quarantine them.

Let p with $0 \leq p \leq 1$ be an effectiveness of this prevention policy (that is the reduction in contact rate among asymptomatic infected human and susceptible human), applying such policy causes the following transformation in the model: $\rho \rightarrow (1 - p)\rho$. The impact of such prevention (p) on total outbreak size presents in Fig. 9a, and impact on peak prevalence presents in Fig. 9b. Our finding suggests that enhancing p by at least 72% the total outbreak size will be reduced from 94.65% to nearly 2.772%, whereas the peak prevalence reduces by 18%.

9.3 Prevention programme quarantined, isolation and rapid hospitalisation

In the real field of Indian scenario, we have observed that many staffs of quarantine and isolation centre (hospital) are infected by the quarantined and isolated infected person. In the model, q_1 and q_2 represent the effectiveness of quarantine and isolation, respectively. For perfect quarantine and isolation, $q_1 = 1$ and $q_2 = 1$ but real information suggests that $q_1 < 1$, $q_2 < 1$. So we have to focus on perfect quarantine and isolation and our model suggests that by increasing q_1 from 0.94 to 1.0 and q_2 from 0.9 to 1.0 simultaneously the total outbreak size reduces by 2.19% and this fact is presented graphically in Fig. 10a.

Our another observation is that according to our estimation the rate of hospitalisation from non-quarantine infected (η_i) and quarantine infected classes η_q are 0.26 and 0.40, respectively. We have to increase these rate to control the COVID-19 outbreak. If we increase these rates up to 0.5 and 1.0, respectively, then the total num-

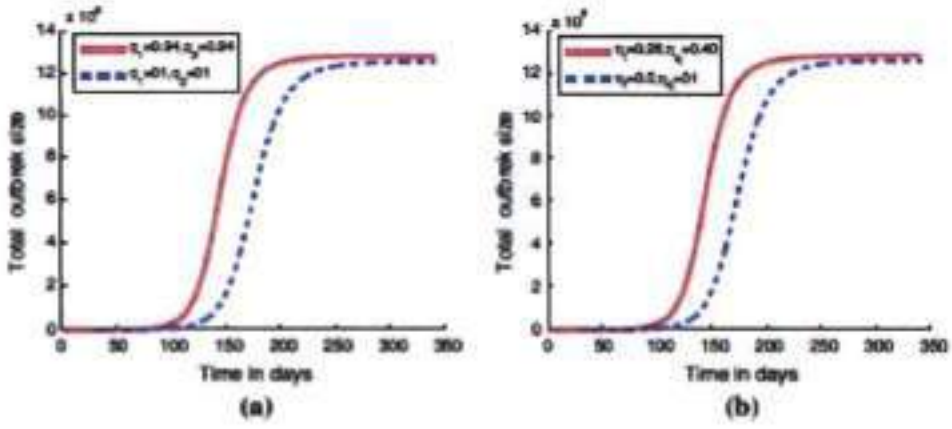

Fig. 10 Time series of total outbreak size for **a** original parameter (solid line) and increase values (dash line) of q_1 and q_2 and **b** original parameter (solid line) and increase values (dash line) of η_1 and η_2

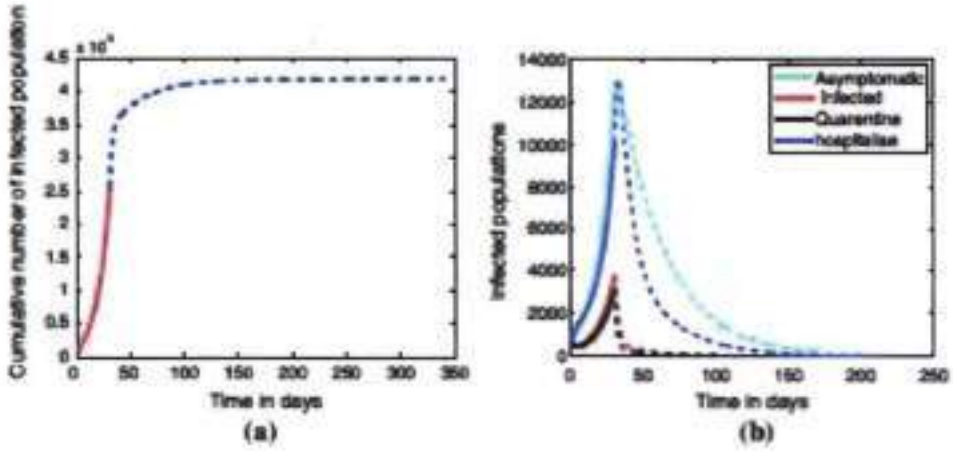

Fig. 11 Time series for **a** cumulative number of infected population due to control apply from 25 April 2020 (blue dash line) **b** time series of infected classes due to control apply from 25 April 2020 (dash line)

ber of infected population will be decreased by 2% whose graphical presentation is given in Fig. 10b. By both the above said preventions, the outbreak can also be delayed.

In order to control this outbreak, we have to apply above said prevention programmes simultaneously. In this case, we increase the values of parameters d, p, q_1, q_2, η_i and η_q from the estimated values (Table 3) to the values $d = 0.2, p = 0.5, q_1 = 1, q_2 = 1, \eta_i = 0.5, \eta_q = 1$ and the other parameters remain same (Table 3). Now, using the above changed parametric values we continue the time series of cumulative number of infected population with the previous series from 24 April 2020 for the next 311 days in Fig. 11a. In Figure, red solid line denotes the real scenario (generates for the estimated parameter values) for the time period 25 March to 24 April 2020 and the dash blue line presents the proposed time series generated due to control. Under the above control, the number of cumulative infected population will be 4.194×10^4 and the disease will be dead after a short-time period. The effect of the above said control on the various infected classes is presented in Fig. 11b; here, solid line denotes the time series for the estimated parameter for the first 31 days after implement of lockdown, and then, we apply the control and the corresponding time series is denoted by dash line. Under the above control, the prevalence will be maximum around on 27 April 2020 and the disease will be dead around on 31 August 2020.

10 Conclusions

In this work, we have formulated a deterministic compartmental model to study the dynamics and future trend of COVID-19 outbreak in India and to give prediction on the future outbreak. First, we study the basic properties of the model and find the expression of the basic reproduction number and different contributory part contributed by different infected classes. We investigate the local stability of the disease-free equilibrium

point, which is locally asymptotically stable for $R_0 < 1$ and unstable for $R_0 > 1$.

To fit the proposed model to the reported cumulative data of COVID-19 outbreak in India, we have estimated the model parameters. In this connection, we consider two sets of data. The first set contains the cases reported during the period 1 March to 24 April 2020. On the other hand before the implementation of lockdown (25 March 2020), many symptomatic as well as asymptomatic infected person came into India from other COVID-19 pandemic country which are neither detected nor reported properly. So there remain uncertainty among the data reported during the period 1 March to 24 March 2020. Thus, we consider the second set of data reported during the period 25 March to 24 April 2020 by avoiding the data reported in above said period. We have fitted the model to the both sets of data and estimate two sets of parameters. Using the estimated parameter (from set-2), we compute the average basic reproduction number which is $R_0 = 2.414190966$ among which the contributions of asymptomatic, symptomatic, quarantine, hospitalise infected classes are $R_{0A} = 1.842473415$, $R_{0I} = 0.3910030945$, $R_{0Q} = 0.01860012179$, $R_{0H} = 0.162\,1143316$, respectively. According to our sensitivity analysis, the virus transmission rate (β), lockdown effect (d), proportion of infection rate of asymptomatic class in compare to symptomatic class (ρ), recovery rate from asymptomatic class (γ_a) are the most influential parameter. The basic reproduction number calculated from actual data lies between 1.99 and 2.10. The study of the effective basic reproduction number shows that it declines from 6.91 to 1.995.

Our findings show that the outbreak size and peak prevalence can be reduced from 100 to 13% and from 37.77 to 0.28%, respectively, by increasing the proportion of the people who maintain the safe distance from each other (d) by 0.77. The findings show that increasing the proportion of asymptomatic infected population detected and isolated (p) by at least 72% the total outbreak size will be reduced from 94.65% to nearly 2.772%, whereas the peak prevalence reduces by 18%.

Our findings suggest that the dramatical reduction in total outbreak size and peak prevalence is possible by increasing d (the proportion of number of population who maintain safe distance from each other) in a certain level and p (the proportion of number of asymptomatic population who are detected and isolated from the other susceptible population) in a certain level. We also have to increase the detection (on the basis of diagnostic test)and hospitalize rate (η_I, η_q) to a certain level.

Acknowledgements The authors would like to thank the anonymous reviewers and the Honourable editor for their careful reading, useful comments and constructive suggestions for the improvement of the manuscript of the present research work.

Compliance with ethical standards

Conflict of interest The authors declare that there are no conflict of interests with publication of this work and no financial support from any agency.

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MEMORANDUM
OF UNDERSTANDING

Between

Dr.Amit Kumar Kundu

Dr. Monojit Roy

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Memorandum of Understanding

Between

Monojit Roy
Barrackpore Rastraguru Surendranath College
And
Amit Kumar Kundu
Sripat Singh College

Subject: Assessment of Drinking Water Quality of Different Municipal Supply Water of North 24 Parganas, West Bengal, India: A Comparative Study

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Abstract

Clean and safe water is essential and significant for our daily life. With the unprecedented increase in population and the development of industrialization, the quality of municipal supplied water is being gradually endangered. Municipal supplied water plays a major role in drinking purposes in many urban areas of West Bengal, India. In this present study, the quality of the municipal drinking water samples of fourteen municipal areas within the North 24 Parganas district of West Bengal have been assessed. We have measured pH, TDS (Total Dissolved Solids), salinity, conductance, sodium ion concentration, potassium ion concentration, and pesticide residue concentration. Investigated water samples showed moderate salinity values and low to high ranges of conductance values. We have also encountered high sodium ion content in three municipality supply waters, whereas we got moderately low concentrations of potassium ion in these drinking water samples. Several water samples showed relatively high pH, another showed a very high TDS value, while eight municipal supply waters showed moderate TDS values. During the study of seventeen pesticide residues in these municipal drinking water samples, no sample water contained pesticide concentration higher than the BIS (Bureau of Indian Standards) limit.

SRIPAT SINGH COLLEGE 1949 JIAGANJ, MSD

DR. KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Memorandum of Understanding

1. Purpose

The purpose of this Memorandum of Understanding (MoU) is to establish the terms and conditions under which Monojit Roy of Barrackpore Rastraguru Surendranath College and Amit Kumar Kundu of Sripat Singh College will collaborate on the assessment of the drinking water quality of different municipal supply waters in North 24 Parganas, West Bengal, India.

2. Scope of Work

- The study will involve the collection and analysis of water samples from fourteen municipal areas within North 24 Parganas.
- The parameters to be measured include pH, TDS, salinity, conductance, sodium ion concentration, potassium ion concentration, and pesticide residue concentration.
- Both parties will jointly conduct the analysis, share data, and prepare the final report.

3. Roles and Responsibilities

- Monojit Roy: Responsible for overseeing the collection of water samples and conducting the analysis of pH, TDS, and salinity.
- Amit Kumar Kundu: Responsible for analyzing conductance, sodium ion concentration, potassium ion concentration, and pesticide residue concentration.

4. Collaboration and Data Sharing

- Both parties agree to share all data and findings related to the study.
- The data will be used solely for the purpose of the study and publication in academic journals.
- Any publication or presentation of the findings will be jointly authored by both parties.

5. Duration

This MoU will remain in effect from the date of signing until the completion of the study and publication of the results.

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DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College

6. Financial Implications
- Each party will bear their own costs incurred in the course of the study.
- Any external funding or grants secured for the project will be shared as per mutual agreement.

7. Confidentiality
Both parties agree to maintain the confidentiality of any proprietary or sensitive information exchanged during the course of the study.

8. Termination
This MoU can be terminated by either party with a written notice of 30 days.

9. Dispute Resolution
Any disputes arising from this MoU will be resolved through mutual discussion and negotiation.

Dr. Monojit Ray
Signatures-

Monojit Roy
Barrackpore Rastraguru Surendranath College
Date: _____

Amit Kumar Kundu
Sripat Singh College
Date: 18/02/21

Principal
Barrackpore Rastraguru
Surendranath College

Principal
Sripat Singh College

SRIPAT SINGH COLLEGE ESTD- JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj

Barrackpore Rastraguru Surendranath College

(Affiliated to University of Calcutta)

[illegible]

Date: 02/03/21

To Whom It May Concern

This is to certify that the college has no objection if Prof. Dr. Mr. Ms **Monojit Ray** will undergo collaborative research with **Department of Chemistry, Sripat Sing College** for 12 months with effect from **02.03.2021**

Deb Roychowdhury

Sri Deb Roychoudhury

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Recent Trends in Environment, Climate Change, Physical and Life Sciences
ISBN: 978-81-89140-22-9

Assessment of Drinking Water Quality of Different Municipal Supply Water of North 24 Parganas, West Bengal, India: A Comparative Study

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Abstract
Clean and safe water is essential and significant for our daily life. With unprecedented increase in population and development of industrialization, municipal supplied water quality is being gradually endangered. Municipal supplied water playing a major role for drinking purpose in many parts of urban areas of West Bengal, India. In this present study the quality of the municipal drinking water samples of fourteen municipal areas within the North 24 parganas district of West Bengal have been assessed. We have measured pH, TDS (Total dissolved solid), salinity, conductance, sodium ion concentration, potassium ion concentration and pesticide residue concentration. Investigated water samples showed moderate salinity values and low to high ranges of conductance values. We have also came across high sodium ion content in three municipality supply water, whereas we got moderately low concentration of potassium ion in these drinking water samples. Several water samples showed relatively high pH, another showed very high TDS value, while eight municipal supply water showed moderate TDS value. During the study of seventeen pesticide residues in these municipal drinking water samples, no sample water contains pesticide concentration higher than the BIS (Bureau of Indian Standards) limit.

Keywords: Municipal water, pH, TDS, Salinity, Pesticide residue

INTRODUCTION

Access to clean and safe municipality supply water is very significant and fundamental for our everyday life This water is used mainly for drinking and all other household purposes by the people. So, the quality of such water has immense importance to us [1, 2]. Near about 1.1 billion people in the world or 15% of the global population is consuming unsafe water [3]. In many countries drinking water does not meet WHO (World Health Organization) standards [4, 5]. In every year near about 3.1% deaths take place due to poor and unhygienic water [6]. For water pH denoted acidic character present, TDS denotes total dissolved solid present, salinity denotes amount of salt present and conductance denotes population of ions present [7,8]. Pesticides are basically used to shield the plants followed by increasing agricultural production and to protect human health [9]. Previous studies showed that a small percentage of pesticide application is going to the target pest, but maximum are going to the environment [10]. However, heavy pesticide use can cause a potential public health hazard [11]. Long-term exposure to pesticide residue may lead to various diseases like cancer, asthma, allergies as well as neurotoxic diseases [12]. Due to long residence time in water of few pesticide residues like, lindane , HCH, endosulfan, aldrin, etc. we have a huge concern to scrutinize these compounds in municipal drinking water.

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In this perspective we had determined the contamination level of pesticide residue in municipal drinking water.

We had studied seventeen pesticides as these pesticides are used in this geographic region for agricultural purposes. The municipal areas subjected for investigations were Naihati, Bhatpara, Halisahar, Kanchrapara, Garulia, Barrackpore, North Barrackpore, Barrackpore Cantonment Board, Titagarh, Khardah, Panihati, Kamrhati, South Dumdum and Barasat. All the pesticides were found below the limit of the BIS:10500: 2nd revision (2012) [13] for all the samples of municipal supply waters. On the other hand, sodium and potassium ions are major and essential cations in intracellular fluid of human body. Sodium ion regulates, blood pressure, blood volume, osmotic pressure and of pH of human blood and potassium is the most important intracellular ion [14, 15]. Concentration of sodium ion and concentration of potassium ion within human body fluid and blood are almost constant [16]. The exact concentrations of the ions are different for different type of cells. The extracellular potassium ion concentration is 0.2 gm/lit (approx), at the same time; the intracellular potassium ion concentration is 6 gm/lit (approx) [17]. The extracellular sodium ion concentration is 3.45 gm/lit (approx), whereas, the intracellular sodium ion concentration is 0.23 gm/lit (approx) [18].

The objective of the present study is to elucidate the differences of municipal drinking water quality in several municipal areas. The outcome of this study will help to the upcoming investigation in the ground of environmental exposure assessment and human health.

MATERIALS AND METHODS

Water samples were collected from fourteen different municipal water supply taps using sterilized sampling bottle during December 2019 to February 2020. At least three samples were collected from each municipal area. pH, TDS, salinity and conductance of the municipal water samples were measured using UTECH made PCSTester 35 at environmental chemistry laboratory of Barrackpore Rastraguru Surendranath College, Barrackopre, North 24 Parganas, WB. Sodium ion and potassium ion concentration in water samples were measured using Systronics (India) Limited made flame photometer made Flame photometer 128 μC at environmental chemistry laboratory of Barrackpore Rastraguru Surendranath College, Barrackopre, North 24 Parganas, WB. Approximately, 1lit drinking water sample were collected in pre-cleaned high-density polyethylene bottles (HDPE) from 14 municipal areas for analyses of pesticide residues, following EPA Method 525.2, Revision 2.0 (J.W. Munch, 1995) [19]. All samples were transported within 72 hours in sealed and refrigerated containers with ice, and were kept at 4°C and processed within 10 days.

All analysis were performed in triplicate for each sample for seventeen number of pesticide residues in collected municipal water samples; namely Alachlor, Atrazine, Alpha-HCH, Beta-HCH, Butachlor, Chlorpyriphos, Delta-HCH, Endosulfan-1, Endosulfan-2, Endosulfan Sulphate, Ethion, Lindane, Malathion, op-DDT, Parathion-methyl, Phorate and pp-DDT were measured quantitatively through GC-MS/MS (Triple Quad. System, Model: Trace 1310 & TSQ Duo, Thermo Scientific) following EPA Method 525.2, Revision 2.0 (J.W. Munch, 1995) at Haringhata Subdivisional Laboratory, Public Health Engineering Department, Government of West Bengal, Kalyani, Nadia.

RESULTS AND DISCUSSION

Within the studied municipal waters the pH value ranges between 7.27 to 8.06. The TDS values are above 500 mg/lit for Halisahar, Kanchrapara, North Barrackpore and South Dumdum municipal water samples. The average TDS value of South Dumdum municipal water was 973 mg/lit. Bhatpara municipal water had shown lowest TDS value among all (212 mg/lit). Salinity value recorded minimum for Bhatpara and maximum for South Dumdum waters. Salinity ranged between 150 – 398 mg/lit except South Dumdum which was found exceptionally high as 684 mg/lit. Conductance study results a wide variation and ranges within 297 -1398 mg/lit. Sodium ion concentration was lowest for Barrackpore Cantonment Board supply water. Sodium ion concentrations were found within the range 36.83 – 122.38 mg/lit. Potassium ion concentration for Naihati, Bhatpara, Titagarh municipal waters were below 5 mg/lit. All the other samples showed values above 7 mg/lit, while Barrackpore municipal water showed average value 6.8mg/lit.

The BIS limits for different pesticides are mentioned in Table 2A and Table 2B. All the pesticides present in all samples were below BIS limits. Herbicide alachlor having the half life in aerobic soil ranges from about 6 to 15 days. Continuous use of this herbicide may cause

Table 1: Average Physico chemial parameters, sodium and potassium ion concentration data of different municipal supply water (within study period)

Samples collected from Municipaly Area	pH	TDS (mg/lit)	Salinity (mg/lit)	Conductance (μ mho/cm)	Sodium ion (mg lit)	Potassium ion (mg/lit)
Naihati	7.80	260	176	366	38.45	4.77
Bhatpara	7.73	212	150	297	37.69	4.59
Halisahar	7.36	517	355	730	52.71	8.94
Kanchrapara	7.27	555	382	786	65.28	8.36
Garulia	7.44	499	340	706	87.61	8.44
North Barrackpore	7.51	579	398	815	116.84	7.57
Barrackpore Cantonment Board	7.99	245	166	346	36.83	8.30
Barrackpore	7.57	440	300	622	116.38	6.81
Barasat	7.86	341	232	481	58.73	9.28
Titagarh	7.61	349	234	491	84.72	4.77
Khardah	7.90	420	286	592	86.38	9.12
Panihati	7.83	262	177	369	41.10	8.53
Kamarhati	7.90	260	176	366	42.16	9.19
South Dumdum	8.06	973	684	1398	122.38	9.28

Table 2A: Pesticide data of different municipal supply water (within study period) [μg/lit]

Pesticide Residue	BSI Limit (μg/lit)	Naihati (μg/lit)	Bhatpara (μg/lit)	Halisahar (μg lit)	Kanchrapara (μg/lit)	Garulia (μg lit)	North Barrackpore (μg/lit)	Barrackpore Cantonment Board (μg lit)
Alachlor	20	0.0142	0.0049	0.0216	0.0072	0.0169	0.0075	0.0146
Atrazine	2	0.0173	0.0047	0.0099	0.0129	0.0049	0.0104	0.0053
Alpha-HCH	0.01	0.0043	0.0026	0.0031	0.0025	0.0017	0.0042	0.0027
Beta-HCH	0.04	0.0078	0.0008	0.0055	0.0017	0.0031	0.0096	0.0077
Butachlor	125	0.0045	0.0227	0.0040	0.0536	0.0019	0.0153	0.0052
Chlorpyriphos	30	0.0056	0.0061	0.0045	0.0315	0.0045	0.0187	0.0223
Delta-HCH	0.04	0.0065	0.0030	0.0047	0.0052	0.0026	0.0068	0.0067
Endosulfan-1	0.4	0.0062	0.0057	0.0041	0.0014	0.0026	0.0211	0.0035
Endosulfan-2	0.4	0.0037	0.0015	0.0028	0.0087	0.0015	0.0078	0.0057
Endosulfan Sulphate	0.4	0.0033	0.0018	0.0188	0.0036	0.0013	0.0072	0.0173
Ethion	3	0.0135	0.0202	0.0063	0.0024	0.0101	0.0085	0.0416
Lindane	2	0.0028	0.0039	0.0020	0.0058	0.0011	0.0174	0.0073
Malathion	190	0.0055	0.0053	0.0042	0.0239	0.0024	0.0097	0.0008
op-DDT	1	0.0053	0.0006	0.0077	0.0062	0.0023	0.0082	0.0042
Parathion-methyl	0.3	0.0101	0.0074	0.0071	0.0040	0.0042	0.0044	0.0088
Phorate	2	0.0029	0.0473	0.0400	0.0027	0.0283	0.0070	0.0360
pp-DDT	1	0.0090	0.0062	0.0257	0.0063	0.0039	0.0018	0.0015

hepatotoxicity or hemosiderosis [20]. The highest Alachlor found in South Dumdum municipal water. The chronic toxicity for isomers of Hexachlorocyclohexane (HCH) decreases in the order beta > alpha > gamma > delta and is directly related to their tissue retention, and inversely to rates of metabolism. This contrasts with the order of acute toxicities, which are in the decreasing order of gamma > alpha > delta > beta. Phorate ($C_7H_{17}O_2PS_3$) which is an organophosphate used as an insecticide. Lindane, or *gamma*-hexachlorocyclohexane (γ-HCH) i.e., gammaxene is a moderately hazardous agricultural insecticide and it is used over last fifty years [21]. It can affect the human nervous system in case of severe poisoning [22]. Endosulfan is an organochlorine insecticide due to its acute toxicity, potential for bioaccumulation, and its role as an endocrine disruptor [23]. It has two isomers, endo and exo, are known commonly as Endosulfan-1 and Endosulfan-2. Endosulfan sulfate is a oxidation product having one extra O atom attached to the S atom.

Table 2B: Pesticide data of different municipal supply water (within study period)

Pesticide Residue	BSI Limit (µg/lit)	Barasat (µg/lit)	Titagarh (µg/lit)	Khardah (µg/lit)	Panihati (µg/lit)	Kamarhati (µg/lit)	South Dumdum (µg/lit)	Barrackpore (µg lit)
Alachlor	20	0.0151	0.0017	0.0045	0.0032	0.0250	0.0287	0.0093
Atrazine	2	0.0133	0.0075	0.0160	0.0194	0.0183	0.0048	0.0329
Alpha-HCH	0.01	0.0015	0.0040	0.0037	0.0028	0.0014	0.0014	0.0014
Beta-HCH	0.04	0.0028	0.0074	0.0066	0.0050	0.0015	0.0026	0.00037
Butachlor	125	0.0029	0.0079	0.0046	0.0031	0.0015	0.0020	0.0284
Chlorpyriphos	30	0.0030	0.0008	0.0067	0.0041	0.0036	0.0035	0.0625
Delta-HCH	0.04	0.0023	0.0062	0.0056	0.0042	0.0013	0.0022	0.0029
Endosulfan-1	0.4	0.0022	0.0027	0.0055	0.0044	0.0012	0.0021	0.0058
Endosulfan-2	0.4	0.0014	0.0239	0.0031	0.0024	0.0007	0.0013	0.0015
Endosulfan Sulphate	0.4	0.0012	0.0086	0.0028	0.0021	0.0007	0.0011	0.0336
Ethion	3	0.0807	0.0098	0.0333	0.0236	0.0037	0.0055	0.0248
Lindane	2	0.0010	0.0005	0.0024	0.0018	0.0006	0.0009	0.0106
Malathion	190	0.0020	0.0061	0.0048	0.0036	0.0014	0.0019	0.0029
op-DDT	1	0.0037	0.0012	0.0048	0.0034	0.0011	0.0018	0.0115
Parathion-methyl	0.3	0.0037	0.0255	0.0098	0.0070	0.0020	0.0036	0.0063
Phorate	2	0.0197	0.0052	0.0267	0.0527	0.0096	0.0282	0.0203
pp-DDT	1	0.0032	0.0023	0.0078	0.0057	0.0018	0.0031	0.0066

Endosulfan is neurotoxic and a Ca^{2+}, Mg^{2+} ATPase inhibitor and chronic exposure to endosulfan leads to skin rashes and irritations [24]. Atrazine is the triazine class herbicide; frequently used for prevention of pre- and post emergence broad leaf weeds in crops like corn, sugarcane and on turf, such as golf courses and residential lawns. Herbicide butachlor and organophosphate pesticide chlorpyrifos generally used to kill pests, insects and worms [25]. Organophosphate insecticide Malathion, Parathion methyl and organochlorine insecticides Dichlorodiphenyl trichloroethanes (op-DDT & pp-DDT) are also significant and determined. Relatively low chlorpyrifos found in Titagarh municipal water (0.0008 µg/lit) and comparatively high chlorpyrifos in Barrackpore municipal water (0.0625 µg/lit).

CONCLUSION

According to World Health Organization (WHO) drinking water having TDS value less than 300mg/lit are "Excellent" and that having between 300mg/lit to 600 mg/lit are "Good". According to BSI standard pH of drinking water must be between 6.5 to 8.5 whereas total dissolved solid must lie below 500 mg/lit. All the municipal waters showed tolerable pH. TDS values are within range except Halisahar, Kanchrapara, North Barrackpore and South Dumdum water supply. Conductance value which reflects ion contents was maximum for South Dumdum and minimum for Bhatpara municipal waters. Sodium ion concentration found highest for South Dumdum water and relatively low for Naihati, Bhatpara, Barrackpore Cantonment Board, Panihati and Kamarhati water samples. Naihati, Bhatpara, Barrackpore and Titagarh municipal water showed low potassium ion concentrations.

The highest Alachlor found in South Dumdum municipal water. Alpha-HCH was minimum for Kamarhati and South Dumdum (both 0.0014 µg/lit) and maximum for Naihati (0.0043 µg/lit). Amount of Beta-HCH was minimum for Bhatpara (0.0018 µg/lit) and maximum for North Barrackpore (0.0096 µg/lit). Delta-HCH was found minimum for Kamarhati water (0.0013 µg/lit) and maximum for North Barrackpore (0.0068 µg/lit). Lindane, or *gamma*-hexachlorocyclohexane (γ-HCH) i.e., gammaxene was found minimum for Titagarh water (0.0005 µg/lit) and maximum for North Barrackpore (0.0174 µg/lit). Endosulfan-1, Endosulfan-2, Endosulfan Sulphate were found minimum in Kachrapara water samples (0.0014 µg/lit), Kamarhati water samples (0.0007 µg/lit) and South Dumdum water samples (0.0011 µg/lit) respectively. On the other side minimum Endosulfan-1, Endosulfan-2, Endosulfan Sulphate were found within North Barrackpore municipal water samples(0.0211 µg/lit), Titagarh municipal water samples(0.0239 ppb) and Barrackpore municipal water samples (0.0336 µg/lit) respectively. The presence of Atrazine in municipal waters, found minimum in Bhatpara (0.0047 µg/lit) and maximum in Barrackpore (0.0329 µg/lit). The highest Butachlor was found in Kanchrapara municipal water (0.0536 µg/lit) and minimum in Kamarhati municipal water (0.0015 µg/lit). Lowest Malathion concentration was recorded for Barrackpore Cantonment board supply water (0.0008 µg/lit) and highest for Kanchrapara municipal supply water (0.0239 µg/lit). Kamarhati

municipal water showed minimum Parathion methyl (0.0020 µg/lit) where as Naihati municipal water showed maximum (0.0101 µg/lit). The presence of op-DDT in municipal waters, found minimum in Bhatpara (0.0006 µg/lit) and maximum in Barrackpore (0.0115 µg/lit). The amount of pp-DDT found minimum in Barrackpore Cantonment Board supply water (0.0015 µg/lit) and maximum in Halisahar water samples (0.0257 µg/lit). All the pesticides found within BIS limit for all the studied fourteen municipal water supply samples. Hence with reference to pesticide content all the municipal supply water is safe. Some municipality viz. Halisahar, Kanchrapara, North Barrackpore and South Dumdum must take care for reducing TDS of supply water. Municipal waters having low potassium ions, used for drinking purpose, are good for kidney patients.

ACKNOWLEDGEMENT

Dr. Monojit Ray is extremely grateful to Governing Body and Research monitoring committee of Barrackpore Rastraguru Surendranath College for financial assistance & funding a research project. The authors are thankful to Executive Engineer, PHE department laboratory, Kalyani, Government of West Bengal for instrumental support.

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MEMORANDUM
OF UNDERSTANDING

Between

Dr.Sagar Simlandy

Mr.Rakibul Islam

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

Memorandum of Understanding

This Memorandum of Understanding (hereinafter referred to as the MOU) is entered into on the 12th day of May, 2021, by and between:

- Mr. Sagar Simlandy, Assistant Professor, Department of History, Sripat Singh College, Jiaganj, Murshidabad
- Mr. Rakibul Islam, Assistant Professor of History, Government General Degree College at Kaliganj, Nadia

Purpose:

This MOU establishes the framework for collaboration between the above parties in the research and publication of an edited book on the History of Education in India.

Clauses of the MOU:

1. Research Ethics and Conflict of Interest:
   - Both parties commit to adhering to strict research ethics.
   - Ideas will be shared transparently.
   - No conflict of interest will be displayed during the publication of documents or research articles.

2. Utilization of Research Grants:
   - Any research grants received from any source will be utilized exclusively for the fulfillment of the project.

Duration of Collaboration:

This MOU will remain in effect until one of the parties decides to withdraw, at which point a written notice should be provided.

Signatures:

Sagar Simlandy

First Party:Mr. Sagar Simlandy

Second Party:Mr. Rakibul Islam

Functionality of the MOU:

Within the scope of this MOU, the following outcome has been achieved:

1. An edited book titled "History of Education in India" was published by Scriptor Publication Pvt. Ltd., Lucknow in February 2022.

Dated: 12th May, 2021

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

University of Kalyani, Kalyani.

Sub: Request for Approval in University Listed Book

Respected Sir,

We have edited a book entitled "History of Education in India" (ISBN-978-93-92203-04-6) by Sagar Simlandy & Rakibul Islam, Department of History, Sripat Singh College, Jiaganj & Govt. General Degree College at Kaliganj, Nadia, published by Scriptor Publication, Uttar Pradesh, India, in the month of May, 2022. We will be highly obliged if you will approve the book as a University Listed Book.

Thanks & regards

Sagar Simlandy

Sagar Simlandy

Editor & Assistant Professor,

Department of History,

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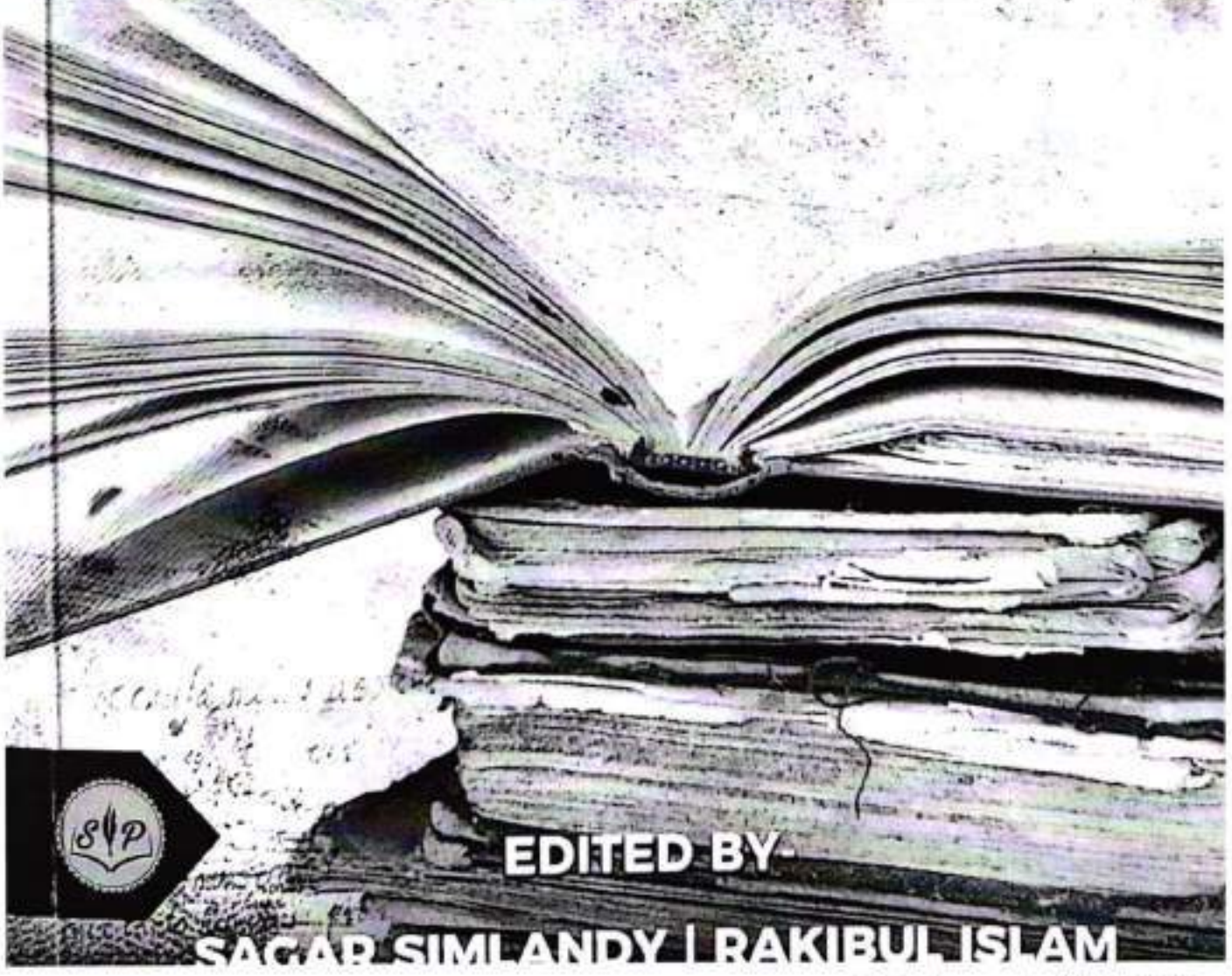

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First Published: May 2022
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ISBN: 978-93-92203-04-6
Price: ₹ 750/-

Scriptor Publication
Building No. 1235/A,
Aloo Thok, Sandi Road, Hardoi,
Uttar Pradesh, India (241001)
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MEMORANDUM
OF UNDERSTANDING

DR. KAMAL KRISHNA SARKAR
Principal
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Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE
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JIAGANJ, MSD.

Between

Mr. Sakti Mandal

Dr. Harish C Karnatak

Memorandum of Understanding

This Memorandum of Understanding (MoU) is made and entered into on this date, 9 June,2020 by and between:

Mr. Sakti Mandal
Assistant Professor,
Department of Geography,
Sripat Singh College,

And

Dr. Harish C Karnatak
Head, GIT&DL Department,
IIRS-ISRO, Dehradun, India

Purpose:

The purpose of this MoU is to establish a collaborative relationship between Sripat Singh College and IIRS-ISRO, Dehradun, for the introduction and conduction of the online course "Satellite Photogrammetry and its Application."

Course Details:
- Course Name: Satellite Photogrammetry and its Application
- Course Starting Date: 29-Jun-2020
- Course Ending Date: 03-Jul-2020
- Course Coordinators at IIRS:
Dr. Anil Kumar / Dr. Hina Pandey
- Discipline:Satellite Photogrammetry and its Application

Responsibilities of Sripat Singh College:

1. Sripat Singh College shall act as a nodal center to conduct the online course offered by IIRS-ISRO, Dehradun.
2. Mr. Sakti Mandal, as the Assistant Professor, Department of Geography, Sripat Singh College, shall oversee the local coordination and management of the course.
3. Ensure that the necessary infrastructure and technical support are available to facilitate the smooth conduction of the online course.
4. Facilitate registration and participation of students and interested individuals for the course.

Responsibilities of IIRS-ISRO:

1. IIRS-ISRO shall provide the course materials, resources, and support required for the conduction of the course.
2. The Course Coordinators, Dr. Anil Kumar and Dr. Hina Pandey, will provide academic and technical guidance throughout the course duration.
3. Ensure the delivery of live and interactive sessions as per the course schedule.

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. MANAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

General Provisions

1. This MoU is valid for the duration of the course from 29-Jun-2020 to 03-Jul-2020.
2. Any amendments to this MoU shall be made in writing and signed by both parties.
3. Both parties agree to work collaboratively and in good faith to ensure the successful delivery of the course.

Signatories:

Sakti mandal

Mr. Sakti Mandal
Assistant Professor, Department of Geography
Sripat Singh College

Hc Karnatak

Dr. Harish C Karnatak
Head, GIT&DL Department
IIRS-ISRO, Dehradun, India

Date: 9 June,2024

SRIPAT SINGH COLLEGE ESTD-1949 JIAGANJ, MSD.

DR. KAMAL KRISHNA SARKAR
Principal
Sripat Singh College
Jiaganj, Murshidabad

SRIPAT SINGH COLLEGE

Estd. 1949. Govt. Sponsored)
P.O. Jiaganj • Dist. Murshidabad • West Bengal-742123
Phone: (03483) 255351, Tele, Fax: (03483) 256961
E-mail sscollege2009@gmail.com *Web: www.sripatsinghcollege.org*

Ref. No: ...Misc, 96, 2020.....
Date: ...05/06/2020.....

To,
The Director
IIRS, ISRO, Dehradun

Sub: Willingness for participating in IIRS Outreach Programmes-reg.

Dear Sir,

Sripat Singh College, the first Govt. Sponsored co-educational degree college in West Bengal, started its journey from 1949 housed in the 'Cutcheri Bari' of great Maharaja Sripat Singh Doogar. Now, this institution receives and enriches teeming youth, catering to the socio-economic-educational-cultural needs of the regions of Murshidabad and its vicinity with its utmost sincerity and efficiency. It has now become an ideal centre of learning, education, research and humanity to shape the Nation. At present the Honours courses in almost all subjects of science and humanities group including Biotechnology and Environmental Science, regular MA course in Bengali, different UG and PG courses under Kalyani University, Nadia.

Contact Details of the focal person/ coordinator:

Name:	**Mr. SAKTI MANDAL**
Designation:	**ASSISTANT PROFESSOR**
Department:	**GEOGRAPHY**
Postal Address:	**69, R.N. TAGORE ROAD, LALDIGHI PLAZA, FLAT NO- C3 5TH FOOR, PIN- 742101, BERHAMPORE, MURSHIDABAD**
Email: (mandatory)	tomblo.sakti@gmail.com
Mobile Number: (mandatory)	**9804302153**

Principal
Sripat Singh College
Jiaganj, Murshidabad

(Signature of Authority)

Gmail

Sakti Mandal <tomblo.sakti@gmail.com>

[SUSPECTED SPAM] IIRS Outreach Programme

2 messages

IIRS Distance Learning <elearning@iirs.gov.in> Tue, Jun 9, 2020 at 5:26 PM
To: Sakti Mandal <tomblo.sakti@gmail.com>

Dear Mr. Sakti Mandal Mandal ,

Thanks for your interest in IIRS Outreach Programme . We have received your online application for our forthcoming online course/webinar . Your registration number is **2020610136017**. Please keep the registration number for any future communications with us.
To complete your registration, please activate your account by clicking on following url or copy and paste it in your browser.
https://elearning.iirs.gov.in/edusatregistration/verifyEmail/dec9221cac65225c585cd70odb12f30d/2020610136017

Your registration for the course /webinar will be confirmed subject to activation of above link and approval by the coordinator of your selected nodal center .
Please note down your course/webinar and coordinator details as mention below:

COURSE DETAILS:
Course No.- 61
Course Name- Satellite Photogrammetry and its Application
Course Starting Date: 29-Jun-2020
Course Ending Date: 03-Jul-2020
Course Coordinator at IIRS: Dr. Anil Kumar/Dr Hina Pandey
Discipline: Satellite Photogrammetry and its Application

YOUR INSTITUTE AND COORDINATOR DETAILS:
Name of your Institute- Sripat Singh College
Name of the Coordinator - Mr.Sakti Mandal
Designation: Assistant Professor
Department: Geography
E-mail address: tomblo.sakti@gmail.com

For any further queries please contact the coordinator of your selected nodal center.

With Regards,
Dr. Harish C Karnatak
Head, GIT&DL Department
IIRS-ISRO, Dehradun, India

IIRS Distance Learning <elearning@iirs.gov.in> Tue, Jun 9, 2020 at 5:26 PM
To: "Mr.Sakti Mandal" <tomblo.sakti@gmail.com>

Dear Mr.Sakti Mandal,

Thank you for your interest in IIRS outreach programme and conducting live & interactive courses at your Institute/Organization. Earlier we have received your request to become network institute of IIRS/ISRO Outreach network. Currently your institute is listed as one of the nodal center to conduct online courses offered by IIRS-ISRO Dehradun. We have received registration request from some of the participants by selecting **your Institute as a nodal center** for conducting comming live & interactive courses as per the following details:

Course Name: Satellite Photogrammetry and its Application
Start Date: 29-Jun-2020 **and End Date:** 03-Jul-2020

Gmail

Sakti Mandal <tomblo.sakti@gmail.com>

[SUSPECTED SPAM] IIRS Outreach Programme

2 messages

IIRS Distance Learning <elearning@iirs.gov.in> Fri, Jul 17, 2020 at 12:03 AM
To: "Mr.Sakti Mandal" <tomblo.sakti@gmail.com>

Dear Mr.Sakti Mandal,

Thank you for your interest in IIRS outreach programme and conducting live & Interactive courses at your Institute/Organization. Earlier we have received your request to become network institute of IIRS/ISRO Outreach network. Currently your institute is listed as one of the nodal center to conduct online courses offered by IIRS-ISRO Dehradun. We have received registration request from some of the participants by selecting your Institute as a nodal center for conducting comming live & interactive courses as per the following details:

Course Name:Basics of Remote Sensing Geographical Information System and Global Navigation SatelliteSystem
Start Date: 17-Aug-2020 and **End Date**: 20-Nov-2020
Institute Name Sripat Singh College

If your institute is currently active and interested to conduct above course/webinar then please click to following link to varify the status:
Click here to keep your institute status as Active

If you are unable to conduct above course/webinar this time at your institute, then please click on following link to stop further registrations by the participants:
Click to stop registration under your institute

For any further query please contact us at edusat@iirs.gov.in or dlp@iirs.gov.in , Tel: +91-135- 2524130.

With regards
Head,
GIT&DL Department
IIRS, Dehardun

IIRS Distance Learning <elearning@iirs.gov.in> Fri, Jul 17, 2020 at 12:15 AM
To: "Mr.Sakti Mandal" <tomblo.sakti@gmail.com>

Dear Mr.Sakti Mandal,

Thank you for your interest in IIRS outreach programme and conducting live & Interactive courses at your Institute/Organization. Earlier we have received your request to become network institute of IIRS/ISRO Outreach network. Currently your institute is listed as one of the nodal center to conduct online courses offered by IIRS-ISRO Dehradun. We have received registration request from some of the participants by selecting your Institute as a nodal center for conducting comming live & interactive courses as per the following details:

Course Name:Remote Sensing and Digital Image Analysis
Start Date: 17-Aug-2020 and **End Date**: 11-Sep-2020
[Quoted text hidden]

Gmail

Sakti Mandal <tomblo.sakti@gmail.com>

IIRS Outreach Programme

1 message

IIRS Distance Learning <elearning@iirs.gov.in> Mon, Jul 20, 2020 at 6:10 PM
To: "Mr.Sakti Mandal" <tomblo.sakti@gmail.com>

Dear Mr.Sakti Mandal,

Thank you for your interest in IIRS outreach programme and conducting live & Interactive courses at your Institute/Organization. Earlier we have received your request to become network institute of IIRS/ISRO Outreach network. Currently your institute is listed as one of the nodal center to conduct online courses offered by IIRS-ISRO Dehradun. We have received registration request from some of the participants by selecting your Institute as a nodal center for conducting comming live & interactive courses as per the following details:

Course Name:RS Applications in Agricultural Water Management
Start Date: 03-Aug-2020 and **End Date:** 07-Aug-2020
Institute Name Sripat Singh College

If your institute is currently active and interested to conduct above course/webinar then please click to following link to varify the status:
Click here to keep your institute status as Active

If you are unable to conduct above course/webinar this time at your institute, then please click on following link to stop further registrations by the participants:
Click to stop registration under your institute

For any further query please contact us at edusat@iirs.gov.in or dlp@iirs.gov.in , Tel: +91-135- 2524130.

With regards
Head,
GIT&DL Department
IIRS, Dehardun

भारत सरकार
अंतरिक्ष विभाग
भारतीय अंतरिक्ष अनुसंधान संगठन
भारतीय सुदूर संवेदन संस्थान, देहरादून

GOVERNMENT OF INDIA
DEPARTMENT OF SPACE
INDIAN SPACE RESEARCH ORGANISATION
INDIAN INSTITUTE OF REMOTE SENSING, DEHRADUN

नामांकन सं. / Enrollment No.: 2020670398009

CERTIFICATE OF PARTICIPATION IN ONLINE COURSE

यह प्रमाणित किया जाता है कि श्री अमर दास को यह प्रमाण पत्र " सुदूर संवेदन और संख्यात्मक मॉडलिंग का तटीय महासागर प्रक्रियाओं की समझ हेतु उपयोग " में ऑनलाइन पाठ्यक्रम में प्रतिभाग करने पर प्रदान किया जाता है। इस पाठ्यक्रम का आयोजन भारतीय सुदूर संवेदन संस्थान (आईआईआरएस), इसरो, देहरादून द्वारा **21 सितंबर, 2020 से 25 सितंबर, 2020 (कुल पाठ्यक्रम अवधि = 7 घंटे 30 मिनट)** के दौरान किया गया ।

This is to certify that MR. AMAR DAS has been awarded this certificate for participation in online course on "Understanding of Coastal ocean processes using Remote Sensing and Numerical Modelling" conducted by Indian Institute of Remote Sensing (IIRS), ISRO, Dehradun during **21-09-2020 to 25-09-2020 (Total course duration = 7 hours and 30 minutes)** .

Date: 23-11-2020
Place: Dehradun

समन्वयक, विश्वविद्यालय/संस्थान
Coordinator, University/Institution

निदेशक/ Director
आई०आई०आर०एस, देहरादून/ IIRS, Dehradun

UID- df13c9d1f6ed72566e6e1df1c27153 .This Certificate can be validated using URL- https://certificate.iirs.gov.in

भारतीय सुदूर संवेदन संस्थान/ INDIAN INSTITUTE OF REMOTE SENSING

भारतीय अंतरिक्ष अनुसंधान संगठन/ INDIAN SPACE RESEARCH ORGANISATION

अंतरिक्ष विभाग, भारत सरकार/ DEPARTMENT OF SPACE, GOVERNMENT OF INDIA

नामांकन सं./ Enrollment No. : 2020620270755

ऑनलाइन दूरस्थ अधिगम प्रमाण पत्र
ONLINE DISTANCE LEARNING CERTIFICATE

पाठ्यक्रम प्रमाणपत्र/ COURSE COMPLETION CERTIFICATE

यह प्रमाणित किया जाता है कि श्री अमर दास को यह प्रमाण पत्र "मास्टर प्लान निरूपण हेतु भू-स्थानिक इनपुट" में ऑनलाइन पाठ्यक्रम पूर्ण करने पर प्रदान किया जाता है। इस पाठ्यक्रम का आयोजन भारतीय सुदूर संवेदन संस्थान (आईआईआरएस) द्वारा 27 जुलाई, 2020 से 31 जुलाई, 2020 के दौरान किया गया । प्रतिभागी ने आईआईआरएस आउटरीच नेटवर्क सेंटर, श्रीपत सिंह कॉलेज से इस पाठ्यक्रम में भाग लिया है।

This is to certify that MR. AMAR DAS has been awarded this certificate on having completed the online course on "Geospatial Inputs for Enabling Master Plan Formulation". The course was conducted by Indian Institute of Remote Sensing (IIRS), during 27-07-2020 to 31-07-2020 . The participant has attended the course at IIRS outreach network centre, Sripat Singh College.

Date: 16-09-2020
Dehradun

Santi Mandal
समन्वयक, विश्वविद्यालय/ संस्थान
Coordinator, University/ Institution

निदेशक/ Director,
आई०आई०आर०एस, देहरादून/IIRS, Dehradun

UID- 8806d170496c298c10f605a711dc2e6b .This Certificate can be validated using URL- https://certificate.iirs.gov.in

अंतरिक्ष विभाग /DEPARTMENT OF SPACE
भारत सरकार/GOVERNMENT OF INDIA
भारतीय अंतरिक्ष अनुसंधान संगठन /INDIAN SPACE RESEARCH ORGANISATION
भारतीय सुदूर संवेदन संस्थान, देहरादून / INDIAN INSTITUTE OF REMOTE SENSING, DEHRADUN

नामांकन सं. / Enrolment No.: 2020640228079

CERTIFICATE OF PARTICIPATION IN

ONLINE COURSE

यह प्रमाणपत्र

श्री अमर दास

को "रिमोट सेन्सिंग, जीआईएस और जीएनएसएस के मूलभूत सिद्धांत"

में ऑनलाईन पाठ्यक्रम में भाग लेने पर प्रदान किया जाता है।

इस ऑनलाइन पाठ्यक्रम का आयोजन 17 अगस्त, 2020 से 20 नवंबर, 2020 (कुल पाठ्यक्रम की अवधि = 84 घंटे) के दौरान किया गया।

THIS CERTIFICATE IS

AWARDED TO

MR. AMAR DAS

ON HAVING PARTICIPATED IN THE ONLINE COURSE ON

"Basics of Remote Sensing Geographical Information System and Global Navigation SatelliteSystem"

THIS ONLINE COURSE WAS CONDUCTED DURING 17-08-2020 to 20-11-2020 (TOTAL COURSE DURATION WAS = 84 HOURS).

इस पाठ्यक्रम में 5 मॉड्यूल शामिल हैं - 1) रिमोट सेंसिंग और डिजिटल छवि विश्लेषण ; 2) ग्लोबल नेविगेशन सैटेलाइट सिस्टम ; 3) भौगोलिक सूचना प्रणाली ; 4) जियोकम्प्यूटेशन और जियोवेब सर्विसेज के मूलभूत सिद्धांत ; और 5) सुदूर संवेदन एवं भौगोलिक सूचना प्रणाली के अनुप्रयोग। This course consists of 5 modules- 1) Remote Sensing and Digital Image analysis; 2) Global Navigation Satellite System; 3) Geographical Information System ; 4) Basics of Geocomputation and Geoweb services; and 5) RS & GIS Applications.

Sakti Mandal

समन्वयक/ Coordinator
आईआईआरएस नोडल केंद्र/ IIRS Nodal Centre

निदेशक/ Director
आई०आई०आर०एस, देहरादून/ IIRS, Dehradun

Date: 04-01-2021
Place: Dehradun
UID: 62bbc91dedf1349000035c60/63a0d1a . This Certificate can be validated using URL- https://e-certificate.iirs.gov.in