सत्यमेव जयते

Government of West Bengal
Government General Degree College, Singur Estd. 2013
Hooghly, W.B. 712409
Office of the Principal
Phone No. 033-2630-0126 **Email: oicsingur@gmail.com**

Ref. No. GGDC-SINGUR-56 **Date:** 3/12/2021

To
The Additional Secretary
to the Government of West Bengal
Department of Science & Technology and Biotechnology
Vigyan Chetana Bhawan, 5th Floor
Block-DD, Plot No. 26/B, Sector-I
Salt Lake City, Kolkata-700 064

Kind Attention: Amiya Kumar Kalidaha, Senior Scientific Officer

Sub: Submission of 1st Year UC, Audited SoE and Yearly Progress Report of my R&D Project on Chemical Sciences entitled: "Synthetic engineering of multitasking small-molecule heterocyclic fluorophores that juggle environmental sensitivity and biological significance"

Sir,

Kindly note that I, Dr. Amrit Krishna Mitra, am having one R&D Project on Chemical Sciences as given in the subject line funded by your Department, DSTBT, GoWB. I have successfully completed the first year of this ongoing project as per the objectives and suggestions received from the Hon'ble Expert Committee Members during my last presentation. I am really indebted to DSTBT, GoWB for providing me the fund for carry out this research at my Institute.

I am here by submitting the five nos. of hardcopies with original signatures of **1st UC, Audited SoE and Yearly Progress Report with publications etc.** related to the said R&D Project for your consideration with a request to release the next installment at the earliest. **I have already uploaded the softcopies/ pdf of these documents at Vigyansathi Portal from my dashboard on 3-12-2021.**

I am ready to go for presentation before the Expert Committee as and when called for.

Thanking you.

With best regards,

Sincerely yours,

Amrit Krishna Mitra

DR. AMRIT KR. MITRA
Asst. Professor
W.B.E.S.-GR.-A
Dept. of Chemistry
Govt. General Degree College, Singur

PI – Name: Dr. Amrit Krishna Mitra,
Designation: Assistant Professor of Chemistry,
Government General Degree College, Singur
Email: amritsepistles@gmail.com, 9432164011
Registration id & date: 57/ASTP/M/C_49358/21 , 2019-11-21
Application id & date: 0226/RND/CHS/C_49358/Feb-2021/1/1 , 2021-02-19

Brotati Chakraborty

Assistant Professor
Department of Chemistry
Bejoy Narayan Mahavidyalaya
Itachuna, Hooghly

Co-PI- Name: Dr. Brotati Chakraborty
Designation: Assistant Professor of Chemistry, Bejoy Narayan Mahavidyalaya, Itachuna
Email: brotati07@gmail.com, 9433701100
Registration id & date: 642/ASTP/F/C_44658/21 , 2019-11-21

Enclo: as stated

Standard Form - I

Utilisation Certificate (UC) in respect of Grant-In-Aid

Date: 24.11.2021

No.

1. Name of the Grantee Institute (s) : Government General Degree College, Singur
2. Sanctioning Authority: West Bengal State Council of Science & Technology
3. Sanction Order Number & Date : 1855(Sanc.)/ST/P/S&T/15G-5/2019 Date: 14/02/2020
4. Amount Sanctioned : Rs. 1,10,000/- [Rupees One Lakh Ten Thousand Only]
5. Drawing & Disbursing Officer : AO, WBSCST
6. Treasury/PAO : -
   [From where the bill was drawn]
7. Bill No. & Date : -
8. T. V. No. & Date: -
9. Amount Drawn : Rs. 1,10,000/-
10. Unspent Balance of Previous year, if any : NA
11. Amount Utilised : Rs. 1,10,000/-
12. Unspent Balance, if any, in Current year : NA
13. Purpose of Utilisation : R&D project entitled Synthetic engineering of multitasking small-molecule heterocyclic fluorophores that juggle environmental sensitivity and biological significance

CERTIFICATE

Certified that I have satisfied myself that the conditions on which the Grant-in-Aid was sanctioned have been duly fulfilled/are being fulfilled that I have exercised the following checks to see that the money was actually utilised for the purpose for which was sanctioned.

[Applicable in case of unspent balance] The unspent fund will be adjusted against the Grant-in-Aid to be sanctioned and paid in the Current Financial Year (applicable in case of recurring grant only).

Kinds of checks exercised

1. Cash Book
2. Ledger
3. SOE (Statement of expenditure)

23/11/21

Dr. SANTANU CHAKRABARTI
WBSES
PRINCIPAL
GOVT. GENERAL DEGREE COLLEGE, SINGUR

P. K. DHARA & CO. Chartered Accountants

Date 24/11/2021

Signature with Official Stamp

(IMPORTANT: UC must be completed in one single A4 page and not to split into more than one page)

Standard Form - II

Yearly Progress Report

1. Name of the PI and Co-PI (if any) with designation, mobile no., e-mail id, Registration id & date and Application id & date (Vigyansathi Portal):

PI – Name: Dr. Amrit Krishna Mitra,
Designation: Assistant Professor of Chemistry, Government General Degree College, Singur
Email: amritsepistles@gmail.com
Registration id & date: 57/ASTP/M/C_49358/21 , 21-11-2019
Application id & date: 0226/RND/CHS/C_49358/Feb-2021/1/1 , 19-02-2021
Co-PI- Name: Dr. Brotati Chakraborty
Designation: Assistant Professor of Chemistry, Bejoy Narayan Mahavidyalaya, Itachuna
Email: brotati07@gmail.com
Registration id & date: 642/ASTP/F/C_44658/21 , 21-11-2019

2. Title of the R&D Project:

Synthetic engineering of multitasking small-molecule heterocyclic fluorophores that juggle environmental sensitivity and biological significance

3. Name and postal address of the Institute of the PI and Co-PI (if any):

Institute of PI - Government General Degree College, Singur **Address:** Jalaghata, Singur, Hooghly: 712409

Institute of Co-PI - Bejoy Narayan Mahavidyalaya, Itachuna **Address:** Itachuna, Hooghly: 712147

4. **Total Approved Budget:** 2,20,000/-
5. **First Sanctioned G. O. No. & Date:** 1855(Sanc.)/ST/P/S&T/15G-5/2019, Date: 14-02-2020
6. **Date of Commencement of the Project:** 28-08-2020
7. **Total Duration of the Project (One year/ Two year/ Three year):** Three years
8. **Last Sanctioned G. O. No. & Date (for which the Yearly Progress Report is given):** 1855(Sanc.)/ST/P/S&T/15G-5/2019, Date: 14-02-2020
9. **Year of the Progress Report (1st year/ 2nd year/ 3rd year):** 1st year

10. Objective(s)/ Academic Landmark of the Sanctioned Project: 1st year/ 2nd year/ 3rd year:

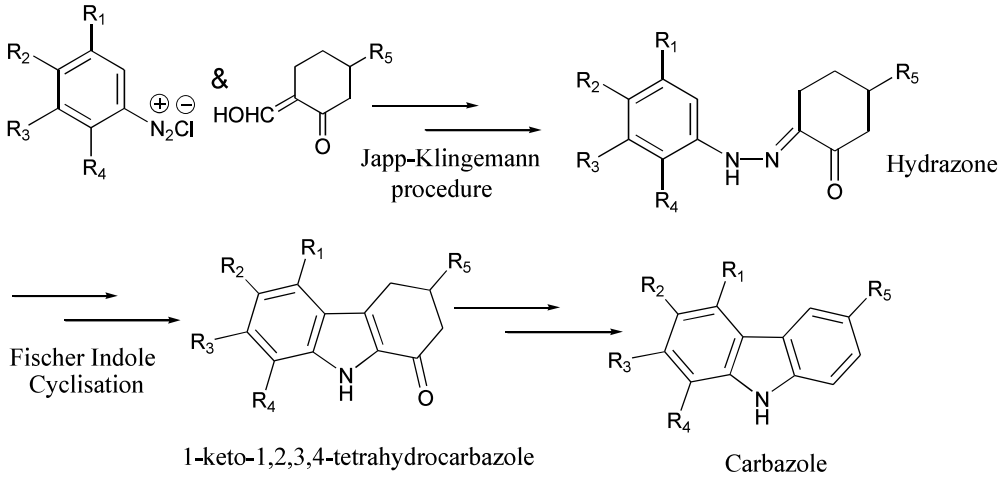
Development of new small molecule environment sensitive heterocyclic fluorophores is always an important field of research in biology, bio-technology and medicine. Our target is to develop a new class of small molecule fluorophores based on heterocyclic skeleton. The environment sensitivity, interactions

with amines, amino acids, cyclodextrins, micelles and proteins are the primary objectives of this research. Development of such fluorophores having biological significances will definitely make a mark in the field of photochemistry and those of medicinal chemistry and material science. These small molecule fluorophores probably can act as light emitting diodes, potential photosensitive biological units, fluorescent markers (with respect to amino acids, peptides, proteins, carbohydrates etc.) in biology, photo-induced electron sensors and in diverse fields of chemistry (photoelectrical dyes, supramolecular recognitions and medicinal chemistry). Since many of the carbazole and indole derivatives are famous for their wide range of biological activities, it has been the core research objective to synthesise several fluorescent derivatives of carbazoles and indoles and to study their photophysics in diverse environments.

Serial	**Quantifiable Landmarks**	**Months**
1	Laboratory Set-up and synthesis of heterocyclic fluorophores (based on Indole skeleton). Characterization of this fluorophores using IR, ^{1}H NMR, ^{13}C NMR, HRMS data.	1 - 12 months
2	Photophysical studies of these compounds.	12 - 24 months
3	Molecular docking analysis and biological studies (if the fluorophores are found to be bio-active)	24- 36 months

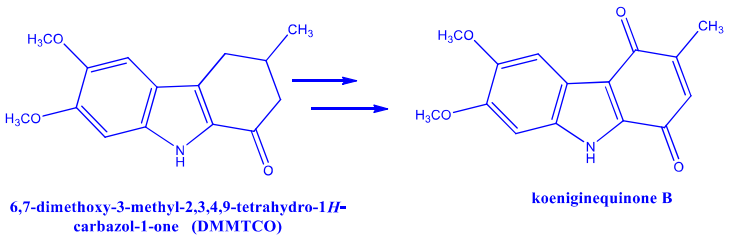
11. Achievement(s) of the Objective/ Academic Landmark (till date of Report):

We have synthesised a few fluorophores based on 1-keto-1,2,3,4-tetrahydrocarbazole [KTHC] skeleton. Japp-Klingemann reaction has been used to synthesise several hydrazones followed by Fischer Indole Cyclisation to obtain the said skeleton [Scheme 1].



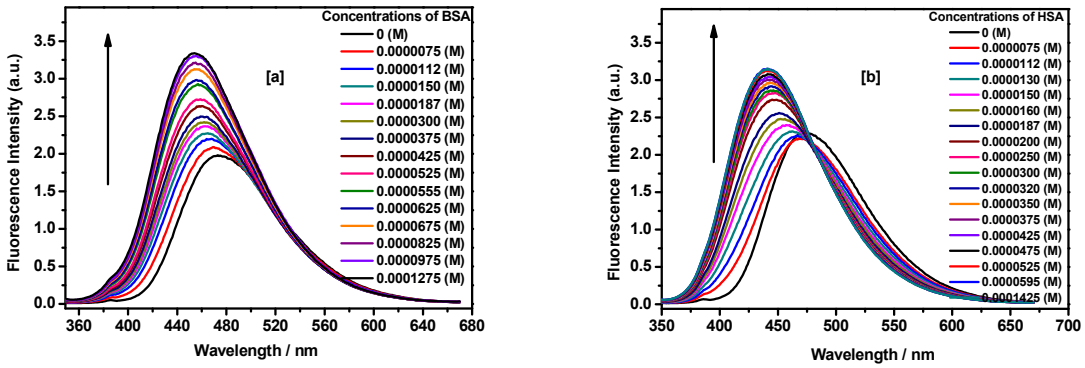
Scheme 1: Synthetic outline to obtain derivatives of 1-keto-1,2,3,4-tetrahydrocarbazole.

We have performed the detailed photophysical studies of a newly synthesized fluorophore, 6,7-dimethoxy-3-methyl-2,3,4,9-tetrahydro-1H-carbazol-1-one (DMMTCO). DMMTCO is a synthetic precursor of koeniginequinone B (biologically active carbazolequinone) [Scheme 2].

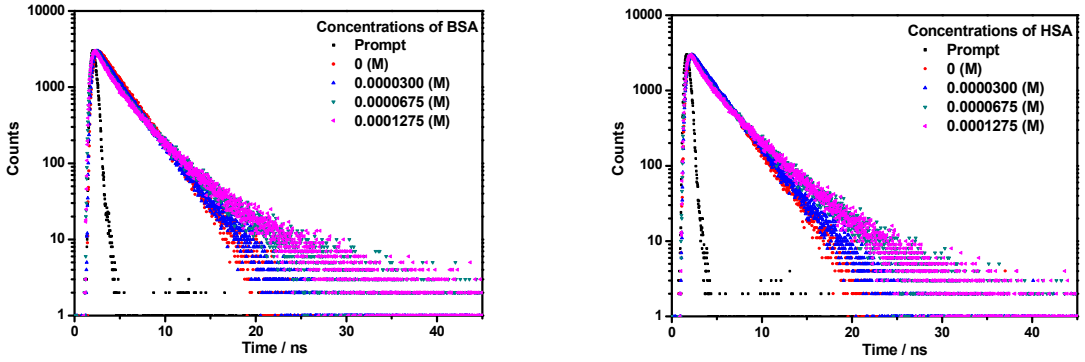


Scheme 2: Representative structures of 6,7-dimethoxy-3-methyl-2,3,4,9-tetrahydro-1H-carbazol-1-one (DMMTCO) and Koeniginequinone B.

Spectroscopic and photophysical study of this molecular system in serum albumin media has been performed meticulously for a better understanding of the nature of binding and bio-distribution in the body. Steady states as well as time-resolved fluorescence techniques have been used as extremely sensitive monitors to explore the interactions between the abovementioned ones [Scheme 3 and Scheme 4].

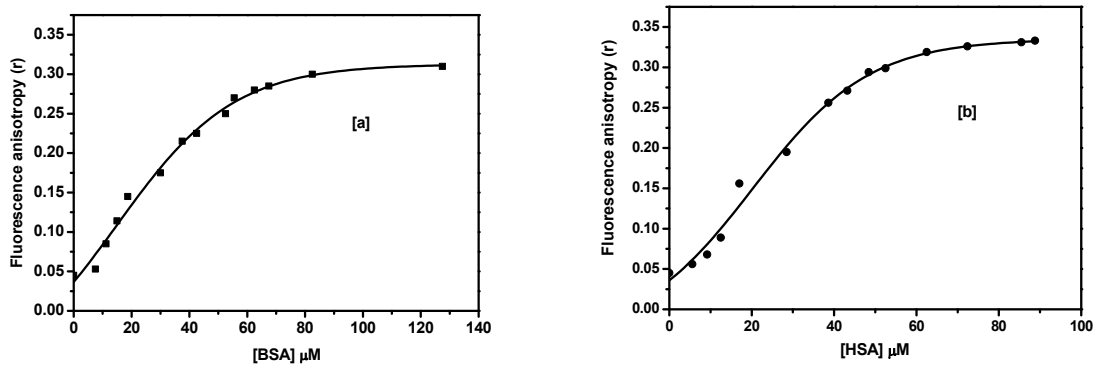


Scheme 3: Fluorescence emission spectra of DMMTCO in presence of different concentrations of (a) BSA and (b) HSA. Emission spectra have been taken exciting the samples at their corresponding absorption maxima.



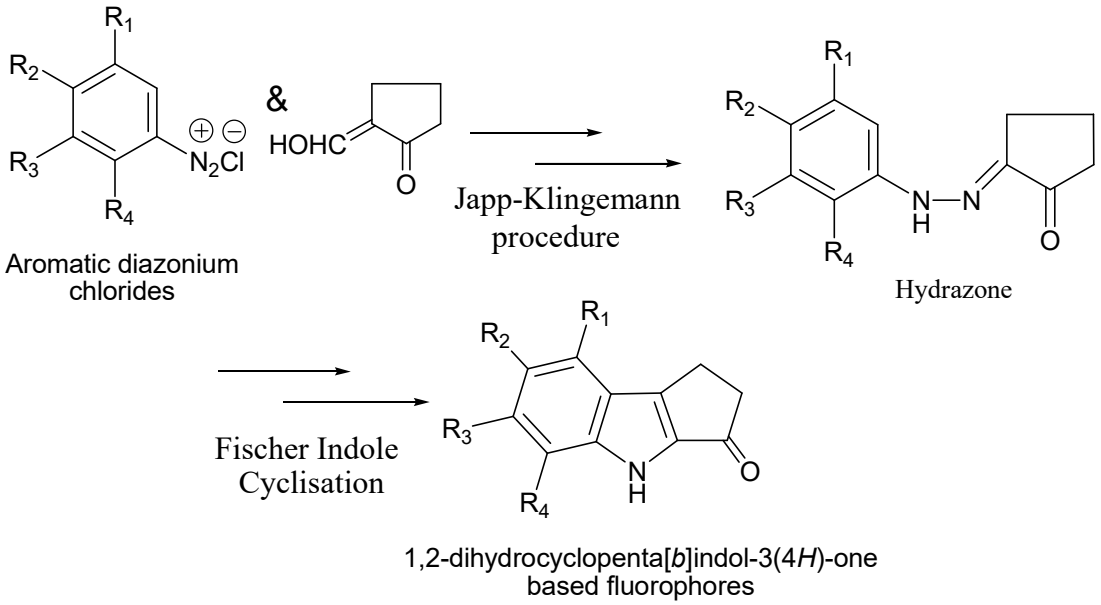
Scheme 4: Fluorescence lifetime plots of DMMTCO (excited using a 340 nm LED) in presence of BSA (a) and HSA (b). Concentration of the compound is 1×10^{-6} M.

Fluorescence anisotropy study has been performed to assess the degree of restrictions imparted by the micro-environments of serum albumins [Scheme 5].



Scheme 5: Variation of fluorescence anisotropy (r) of DMMTCO with increasing concentrations of BSA (a) and HSA (b). λ_{em} is 453 nm for BSA and 440 nm for HSA. Concentration of the compound is 1×10^{-6} M.

Another series of new fluorophores have been synthesised [Scheme 6].



Scheme 6: Synthetic outline to obtain derivatives of 1,2-dihydrocyclopenta[b]indol-3(4H)-one.

Throughout this spectroscopic endeavour attention has been paid to compare the photophysical responses of the said fluorophore within bio-environments of two different albumins.

12. If there is any shortcomings to achieve the objective(s), reason(s) thereof:

We have not been able to synthesise some more fluorophores. Even the biological studies of these skeletons have not been performed yet.

It was due to the Covid-19 pandemic situation that most of the academic and research institutions were not accessible. Hopefully, the pending works can be performed in the second year of the project.

13. **Physical Progress during the reporting year:**

We have been able to synthesise a few fluorophores. However, detailed photophysical studies have been performed on a single fluorophore, 6,7-dimethoxy-3-methyl-2,3,4,9-tetrahydro-1H-carbazol-1-one (DMMTCO). The photophysics of DMMTCO in several homogeneous and microheterogenous systems have been studied in detail.

In this respect, it is worthwhile to mention that a review article has been published by the principal investigator on the synthesis, photophysical and biological studies of carbazole. A book chapter has also been published on the photophysical properties of 1-keto-1,2,3,4-tetrahydrocarbazole based fluorophores.

Again, as we all know, neurotransmitters play the role of electrochemical signalling molecules which are essential for suitable brain functioning. Their dysfunction causes several mental and health disorders. Neurotransmitters are present at a very low concentration in the nervous system and they are mixed with many other biochemical molecules. The neuropeptides oxytocin and vasopressin are the most interesting molecules for social neuroscience and there is a considerable genetic and structural resemblance between these structures. We have planned to study the interactions (if any) between the newly synthesised fluorophores and the neuropeptides oxytocin and vasopressin.

A review article has been published on oxytocin and vasopressin showcasing the chemistry, the social and the psychobiological importance of oxytocin and vasopressin.

14. Quantitative indication of the actual progress vis-à-vis the original proposal submitted to DSTBT (as per Work Plan and Timeline):

For the past one year, a detailed literature survey has been performed and a few fluorophores have been synthesised. Detailed photophysical studies were carried out on one of such fluorophores. Three papers and one book chapter have been published in several UGC approved journals.

However, the synthesis of more such new fluorophores, their biological and photophysical studies are pending. Quantitatively, 25% progress has been made with respect to the original proposal submitted to

DSTBT. Due to the pandemic, most of the academic and research institutions restricted physical entry, thereby hampering the progress to a certain extent. Hopefully, we shall be able to perform better in the ongoing year.

15. **Physical Achievement and Translational Outcome till date, particularly, how the result will help the common people of our State**:

Designing and characterizations of small molecule environment sensitive fluorophores are extremely significant in the viewpoint of bio-chemical and bio-physical studies. They are extremely precious owing to their capability to probe micro-environments which can decipher bulk information in the study of molecular biology, drug discovery, material science, tissue diagnostics, environmental indicators, enzyme substrates and cellular staining agents. Although numerous fluorophores are known in the form of coumarins, fluoresceins, cyanines, oxazines, pyrenes, quinines, bodipy dyes etc., the quest for newer ones is still on as they are extremely essential to visualize a biochemical process. This research venture involves synthesis and photo-physical studies of a new family of fluorophores. Even the interactions of these fluorophores with several biomolecules, neuropeptides and metal ions undoubtedly constitute an important research that will be helpful for the common people of our state especially focussing on the development of new drugs and biomarkers.

16. **No. of papers published/ communicated (with copy) and Book/ Book Chapter/ Book Edited etc.:**

Three papers and one book chapter has been published through this project.

1. Journal of the Iranian Chemical Society [Springer Nature, Impact Factor: 2.019]
Indexed in Scopus, UGC-CARE List (India) and others

Mitra, A.K. Sesquicentennial birth anniversary of carbazole, a multifaceted wonder molecule: a revisit to its synthesis, photophysical and biological studies. *J IRAN CHEM SOC* (2021). https://doi.org/10.1007/s13738-021-02444-0.

2. Current Science [Current Science Association along with the Indian Academy of Sciences. Impact Factor: 1.102].
Indexed in Web of Science, Scopus, UGC-CARE List (India) and others

Mitra, A. K. (2021). Asima Chatterjee, one of the brightest stars in the galaxy of organic chemistry. Current Science (00113891), 127(7).

3. AIMS Molecular Science [AIMS Press. Impact Factor: NA]
Indexed in Web of Science, UGC-CARE List (India) and others
Mitra, A. K. (2021). Oxytocin and vasopressin: the social networking buttons of the body. AIMS Molecular Science, 8(1), 32-50.

4. Book chapter Published by : LINCOLN UNIVERSITY COLLEGE, Malaysia

Mitra, A. K. (2020). Introducing a New Family of Fluorophores: Keto-tetrahydrocarbazole. *Modern Approaches in Chemical and Biological Sciences*, 18. [doi:10.31674/book.2020.macbs]

17. Patents applied (if any): We have not applied for any patent till date. Hopefully, we shall try to do it in future.

18. Remaining Work to be done for the next year:

A. Synthesis of some new small molecule heterocyclic fluorophore.
B. Photophysical studies in several environments.
C. Study related to the interactions of these compounds with several biomolecules.
D. Biological studies of these compounds.

19. Budget utilization as per the sanctioned heads:

Sl No	Sanctioned Heads as per Budget	Amount allotted as per Sanctioned Budget (A)	Expenditure made during the reporting year (B)	Unspent Balance (C=A-B)	Remarks, if any
1.	Consumables	1,00,000/-	1,00,000/-	--	Chemicals and glass goods have been bought for the smooth execution of the project.
2.	Other costs	5,000/-	5,000/-	--	This sanctioned budget has mainly been utilized to buy stationery and a certain amount (2,360/-) from this sanctioned budget has been paid to the Journal Current Science for the print of colour pages for one of the published articles.
3.	Travel	5,000/-	5,000/-	--	Numerous visits were made to various intuitions during the lockdown period.
4.	--	--	--	--	--
	Total	1,10,000/-	1,10,000/-	--	

20. **Any other Special Achievement/ Translational value etc.:** No other special recognition has been achieved till date. We still have two years' time and hopefully something beneficial can be made.

Amrit Krishna Mitra

DR. AMRIT KR. MITRA
Asst. Professor
W B E S -Gr.-'A'
Dept. of Chemistry
Govt. General Degree College, Singur

Brotati Chakraborty

Assistant Professor
Department of Chemistry
Bejoy Narayan Mahavidyalaya
Itachuna, Hooghly

PI – Name: Dr. Amrit Krishna Mitra,

Designation: Assistant Professor of Chemistry, Government General Degree College, Singur

Email: amritsepistles@gmail.com, 9432164011

Registration id & date: 57/ASTP/M/C_49358/21 , 2019-11-21

Application id & date: 0226/RND/CHS/C_49358/Feb-2021/1/1 , 2021-02-19

Co-PI- Name: Dr. Brotati Chakraborty

Designation: Assistant Professor of Chemistry, Bejoy Narayan Mahavidyalaya, Itachuna

Email: brotati07@gmail.com, 9433701100

Registration id & date: 642/ASTP/F/C_44658/21 , 2019-11-21

Audited Statement of Expenditure (Audited-SoE)

1. Name of the PI and Co-PI (if any) with designation, mobile no., e-mail id, Registration id & date and Application id & date (Vigyansathi Portal):

   PI – Name: Dr. Amrit Krishna Mitra,

   Designation: Assistant Professor of Chemistry, Government General Degree College, Singur

   Email: amritsepistles@gmail.com

   Registration id & date: **57/ASTP/M/C_49358/21, 21/11/2019**

   Application id & date: 0226/RND/CHS/C_49358/Feb-2021/1/1, 19/02/2021

   Co-PI- Name: Dr. Brotati Chakraborty

   Designation: Assistant Professor of Chemistry, Bejoy Narayan Mahavidyalaya, Itachuna

   Email: brotati07@gmail.com

   Registration id & date: 642/ASTP/F/C_44658/21, 21/11/2019

2. Title of the R&D Project: Synthetic engineering of multitasking small-molecule heterocyclic fluorophores that juggle environmental sensitivity and biological significance

3. Name and postal address of the Institute of the PI and Co-PI (if any):

   Institute of PI - Government General Degree College, Singur **Address:** Jalaghata, Singur, Hooghly: 712409

   Institute of Co-PI - Bejoy Narayan Mahavidyalaya, Itachuna **Address:** Itachuna, Hooghly: 712147

4. First Sanctioned G. O. No. and Date: 1855(Sanc.)/ST/P/S&T/15G-5/2019 Date: 14/02/2020

5. Date of Commencement of the Project: 28/08/2020

6. Total Duration of the Project (One year/ Two year/ Three year): Three year

7. Last Sanctioned G. O. No. and Date (for which the Audited SoE is given): 1855(Sanc.)/ST/P/S&T/15G-5/2019 Date: 14/02/2020

8. Reporting Year of this Audited SoE (1st year/ 2nd year/ 3rd year): 1st year

Sl No	Sanctioned Heads as per Budget	Amount allotted as per Sanctioned Budget (A)	Expenditure made during the reporting year (B)	Unspent Balance (C=A-B)	Remarks, if any
1.	Consumables	1,00,000/-	1,00,000/-	-	Chemicals and glass goods have been bought for the smooth conduction of the project.
2.	Other costs	5,000/-	5,000/-	-	This sanctioned budget has mainly been utilized to buy stationaries and a certain amount (2,360/-) from this sanctioned budget has been paid to the Journal, Current Science for the print of colour pages for one of the published articles.
3.	Travel	5,000/-	5,000/-	-	Numerous visits were made to various intuitions during the lockdown period.
	Total	1,10,000/-	1,10,000/-	-	

Certified that we have exercised all kinds of checks to see that the grant has been utilized for the purpose for which it was sanctioned by DSTBT, GoWB.

AMRIT KRISHNA MITRA
Amrit Krishna Mitra 28/10/21

23/11/21

Name & Signature with date of Principal Investigator with Official Seal

Assistant Professor
WBES
Govt. Gen. Degree College
Singur, Hooghly

Name & Signature with date of Head of the Institution with Official Seal

Dr. SANTANU CHAKRABARTI
WBSES
PRINCIPAL
GOVT. GENERAL DEGREE COLLEGE, SINGUR

P. K. DHAR & CO.
Chartered Accountants

Proprietor

24/11/21

Name & Signature with date of Chartered Accountant with Official Seal

M. No. 051492

P. K. DHAR & CO. CALCUTTA Chartered Accountants

P. K. DHAR & CO.
Chartered Accountants

Phone : 2230-5796
MERCANTILE BUILDINGS
(2nd Floor)
9, Lal Bazar Street, Kolkata - 1

Utilisation certificate

This is to certify that out of Rs. 1,10,000/- (One lakh ten thousand) only, sanctioned by Department of Science & Technology, Govt. of West Bengal for implementing the project "Synthetic engineering of multitasking small-molecule heterocyclic fluorophores that juggle environmental sensitivity and biological significance" in favour of Government General Degree College, Singur PIN- 712409, vide sanctioned letter no. 1855(Sanc.)/ST/P/S&T/15G-5/2019 Date: 14/02/2020 and Rs. NIL on account of unspent balance of the previous year, a sum of Rs. 1,10,000/- (One lakh ten thousand) only has been utilised for the purpose for which it was sanctioned.

Certified that I have satisfied myself that the condition on which the Grant-in-Aid was sanctioned have been duly fulfilled and that I have exercised the following checks to see that the money was actually utilized for the purpose for which it was sanctioned.

Kind of checks

Cash Book, Pass Book,

Vouchers etc.

For P.K. DHAR & Co.

Chartered Accountants.

Place: Kolkata

Dated: 24-11-2021

P.K. DHAR & CO. CALCUTTA Chartered Accountants

(Pradip Kumar Dhar)

Proprietor.

M.No. 051492

UDIN 21051492AAAAET9590