

Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh

(Formerly U.P. Technical University)

Sector-11, Jankipuram Vistar Yojana, Sitapur Road, Lucknow-226031

Ref No.: Dr. APJAKTU/Dean-PGSR/2017/4236-46

Dated: 09 Aug, 2017

To,

Director/Principal,
Moradabad Institute of Technology, Moradabad (082)

Sub: Regarding Award of Grant under "Visvesvaraya Research Promotion Scheme" for 2017-18

Dear Sir/Madam,

It is my pleasure to inform you that the research project submitted by a faculty member of your institute has been selected for the award of grant under "Visvesvaraya Research Promotion Scheme" for academic year 2017-18. The details of the selected project are as follows:

Title of the project	To improve the efficiency of Solar Photovoltaic System using metallic fins filled with phase change materials	
Name of principal investigator	Dr. Nitin Agarwal	
Amount sanctioned	Non-recurring	Rs. 4,00,000.00
	Recurring (For first year)	Rs. 40,000.00
	Total (For first year)	Rs. 4,40,000.00

Breakup of the research grant released for the first year and the terms and conditions for fund utilization are attached for your reference. You are advised to strictly follow all the terms and conditions as mentioned in this letter as well as given in the information brochure for "Visvesvaraya Research Promotion Scheme" (Copy enclosed). At the end of the scheme, your institute will have to submit a detailed report on the proforma provided by the university with the all relevant documents along with the copies of publication(s) (SCI/SCOPUS Index and/or patents if any) emanating from the project. Due acknowledgement must be given to the university in your publications. University at its discretion may appoint experts to visit your institute to access the progress of the project.

Regards

(Dr. Rajeev Kumar)
Asso. Dean PGS&R

Copy to:

1. Registrar, AKTU, Lucknow
2. Finance officer, AKTU, Lucknow for necessary action
3. Staff officer, AKTU, Lucknow, Hon'ble VC, AKTU, Lucknow

(Dr. Rajeev Kumar)
Asso. Dean PGS&R

Dr. Munish Chhabra

Professor & Head

Deptt. of Mechanical Engg.

Moradabad Institute of Technology

Moradabad - 244001

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Dr. A.P.J. Abdul Kalam Technical University

Uttar Pradesh, Lucknow

Research Project Report

Visvesvaraya Research Promotion Schemes-2017

(AKTU Ref.: Dr. APJAKTU/Dean-PGSR/2017/4236-46)

Project Title: Performance enhancement of solar PV system using phase change materials and metallic fins.

Principal Investigator

Dr. Nitin Agarwal

Professor

Department of Mechanical Engineering

Moradabad Institute of Technology

Moradabad-244001

Co-Principal Investigator

Dr. Abhishek Saxena

Associate Professor


Department of Mechanical Engineering

Moradabad Institute of Technology

Moradabad-244001

Moradabad Institute of Technology

Ram Ganga Vihar, Phase-2, Moradabad - 244001



Dr. Munish Chhabra

Professor & Head

Deptt. of Mechanical Engg.

Moradabad Institute of Technology

Moradabad - 244001

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104/09/21

Dr. Munish Chhabra
Professor & Head
Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

Audited by Chartered Accountant in case private institution and by finance / Account officer in respect of Government / Government aided institution
REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT OF EXPENDITURE UNDER VISVESVARAYA RESEARCH PROMOTION SCHEME

1. Sanction Order No and date: Dr. APJAKTU/Dean-PGSR/2017/4236-46
2. Total Project Cost: Rs. 440,000/-
3. Revised Project Cost: Rs. 440,216/-
(if applicable)
4. Date of Commencement: 21-09-2017
5. Statement of Expenditure:
(Month wise expenditure incurred)

Month & Year	Expenditure incurred / committed
November, 2017	4421
March, 2018	82298
May, 2018	105075
June, 2018	2258
July, 2018	133340
September, 2018	625
October, 2018	3330
November, 2018	700
December, 2018	1708
February, 2019	4402
March, 2019	3145
April, 2019	1520
June, 2019	26196
July, 2019	3729
August, 2019	32202
September, 2019	35267
Total	440216/-

6. Grant received in each year:

(a)	1 st Year	:	Rs. 440,000/-
(b)	2 nd Year	:	NIL
(c)	Interest, if any	:	NIL
	Total (a+b+C)	:	Rs. 440,000/-

Nitin
23-11-2019

Dr. Nitin
Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

1

04/09/21
Dr. Munish Chhabra
Professor & Head
Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

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Statement of Expenditure

Sr No	Sanctioned Heads	Funds Allocated (indicate sanctioned or revised (III))	Expenditure Incurred		Total	Balance as on (date)	Requirement of Funds for next year	Remarks (if any)
(I)	(II)	(III)	1 st Year (IV)	2 nd Year (V)	(VI)= IV+V	(VII) = III - VI		
1.	Manpower costs	--	--	--	--	--	--	--
2.	Consumables	40000	7604	52567	60171	-20171	--	--
3.	Travel	--	--	--	--	--	--	--
4.	Contingencies	--	--	--	--	--	--	--
5.	Others, if any	--	--	--	--	--	--	--
	Recurring Expenditure	40000	7604	52567	60171	-20171	--	--
6.	Non-Recurring Expenditure (Equipment)	400000	320413	59632	380045	19955	--	--
7.	Total	440000	328017	112199	440216	-216	NIL	--

Nitin Agarwal
Prof.(Dr.) Nitin Agarwal

Name and Signature of Principal Investigator

Date: 23-11-2019

Date: 23-11-2019

Rohit Garg
Prof.(Dr.) Rohit Garg

Name & Signature of Head of the Institution

Director (with seal)

Moradabad Institute of Technology

Ram Ganga Vihar, Phase 2

Moradabad



Rajank Kumar
Signature of Competent financial authority

(with seal)

Date: 23-11-2019

**Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh,
Lucknow**

Form of Utilization Certificate

Serial No. 4236-46 Letter No. Dr. APJAKTU/Dean-PGSR/2017/4236-46 Certified that out Rs. 440,000/- of Grant-in-aid sanctioned during the year 2017 infavour of Moradabad Institute of Technology, Moradabad under this office/Department letter no. Dr. APIAKTU/Dean-PGSR/2017/4236-46 given in the margin and Rs. NIL on account of unspent balance of the previous year, a sum of Rs. 440,216/- has been utilized for the purpose of Research project titled "Performance enhancement of Solar PV System using Phase Change Materials and metallic fins." granted by Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow under Visvesvaraya Research Promotion Schemes-2017.

- Total for which it was sanctioned and that the balance of Rs. NIL remaining **unutilized** at the end of the year has been surrendered to AKTU (Vide no. NA, dated NA)
- Certified that I have satisfied myself that the condition of Visvesvaraya Research promotion Schemes, Seminar grant and travel grant on which the grant-in-aid was sanctioned have been duly fulfilled/ are being fulfilled and that I have exercised the checks necessary to see that the money was actually utilized for the purpose for which it was actually utilized for the purpose for which it was sanctioned,

Signature of Beneficiary

Designation **Dr. Nitin Agarwal**

Date... **23-11-2019** Professor
Moradabad Institute of Technology
Moradabad - 244001

For Priyank Kumar & Company
Chartered Accountants

Priyank Kumar

(Membership No. 405557)

UDIN: 19405557AAAAHR2405

23-11-2019

Signature of Institute Director

Designation

Date... **23-11-2019**

Director
Moradabad Institute of Technology
Ram Ganga Vihar, Phase-2
Moradabad

Dr. Munish Chhabra

Professor & Head
Deptt. of Mechanical Engg
Moradabad Institute of Technology
Moradabad - 244001

PROGRESS REPORT

VISVESVARAYA RESEARCH PROMOTION SCHEME

Project Title: Performance enhancement of Solar PV System using Phase Change Materials and metallic fins.	AKTU Ref.: Dr. APJAKTU/Dean-PGSR/2017/4236-46
PI (Name, Address, Phone, Fax, Email): Name: Dr. Nitin Agarwal Address: Professor Department of Mechanical Engineering Moradabad Institute of Technology Moradabad-244001 Phone: 9359397806 Email: nitin23757@gmail.com	Date of Birth: 14-11-1976
3. Co-PI (Name, Address, Phone, Fax, Email): Name: Dr. Abhishek Saxena Address: Associate Professor Department of Mechanical Engineering Moradabad Institute of Technology Moradabad-244001 Phone: 9837623458 Email: talk2abhi3@gmail.com	Date of Birth: 21-11-1979
4. Summary of Progress <ul style="list-style-type: none"> In this project a device has been attached with the solar panels to enhance its efficiency. The device consisted of copper fins filled with Phase change material. Following research equipment have been purchased for experimentation. <ul style="list-style-type: none"> (i) Infrared Thermal Image Camera (ii) Solar Power Radiation Meter (iii) Solar Panels of 200 Wp (iv) Copper Sheets (v) Infrared thermal image camera (vi) High Temperature Infrared Thermometer (vii) 05 Digital Multimeters Following research papers from the project are under review <ul style="list-style-type: none"> (i) Performance enhancement techniques of Photovoltaic systems. (ii) Performance characteristics of a PV system integrated with PCM encapsulated cylindrical tubes for cooling. (iii) Experimental comparison of air, water and phase change material cooling of photovoltaic modules 	
Date of Start: 21/09/2017	Total cost of Project: 4,40,000/-
Date of completion: 21/09/2019	Expenditure as on 21/09/2019: 4,40,216/-

[Signature]
21/09/21

Dr. Munish Chhabra
 Professor & Head
 Deptt. of Mechanical Engg.
 Moradabad Institute of Technology
 Moradabad - 244001

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5. Objective of the Project:

To investigate the use of phase change materials (PCMs) and metallic fins to maintain the temperature of solar panels close to the standard operating temperature at which a solar PV module produce maximum output in terms of electricity.

6. Achievement:

In this project, a device has been designed and manufactured, which when attached with the solar panels increases its efficiency. It extracts heat from the solar panel and dissipates it to the surrounding. Before dissipating, the heat has been utilized to generate power from thermoelectric modules based on the principal of Seebeck effect. The device will be taken to the level of patenting after testing its commercial feasibility.

7. Efforts done by PI on commercial application of the instrument:

As mentioned above, in this project a device consisting of metallic fins and phase change materials has been manufactured to increase the efficiency of solar panels. Thermoelectric modules has been attached with solar panels to increase the output voltage. Commercial feasibility of the device has been discussed with Prof. Lokesh Varshney (Professor, Department of Mechanical Engineering, GBPUAT, Pantnagar). The device will be taken to the level of patenting and thereafter its design will be made available for commercial applications through industries involved in manufacturing of solar panels.

8. Research work which remains to be done under the project (for on-going projects):

Though the project has been completed, still lot of scope is there for future work. The heat dissipated to the surrounding can be further utilized to generate power. For this purpose thermoelectric modules have been attached to the solar panels to generate voltage based on the principal of Seebeck effect. Experiments are still going on in this direction to increase the power output.

Ph.Ds Produced no:

Technical Personnel trained:

Research Publications arising out of the present project:

NIL

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03(under review)

List of Publications from this Project (including title, author(s), journals & year(s))

(A) Papers published only in cited Journals (SCI): NIL

(B) Papers published in Conference Proceedings, Popular Journals etc. NIL

Patents filed/ to be filed:

Solar Panel efficiency enhancement device (To be filed)

9. Major Equipment (Model and Make)

S. N.	Sanctioned List	Procured (Yes/ No) Model & make	Cost (Rs in lakhs)	Working (Yes/ No)	Utilisation Rate (%)
1	Solar panels with frames	Yes (Central Electronics Limited)	1.05075 Lakhs	Yes	100%
2	Solar power radiation meter(Pyranometer)	Yes Model: LPPYRA 03 Make:	0.4484 Lakhs	Yes	80%

		Deltaohm			
3	Infrared Thermal image camera	Yes Model: TESTO 865 Make: TESTO	0.885 Lakhs	Yes	80%
4	Copper sheet	--	0.81998 Lakhs	Yes	70%
5	High Temperature Infrared Thermometer	Yes Model: NV-42545 Make: EXTECT	0.28202 Lakhs	Yes	75%
6	05 Digital Multimeters	Yes Model: EX-410A Make: EXTECT	0.25370 Lakhs	Yes	80%

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Dr. Munish Chhabra 6
Professor & Head
Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

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Dr. A.P.J. Abdul Kalam Technical University.

Uttar Pradesh, Lucknow

Research Project Report

Visvesvaraya Research Promotion Schemes-2017

(AKTU Ref.: Dr. APJAKTU/Dean-PGSR/2017/4236-46)

Project Title: Performance enhancement of solar PV system using phase change materials and metallic fins.

Principal Investigator

Dr. Nitin Agarwal

Professor

Department of Mechanical Engineering

Moradabad Institute of Technology

Moradabad-244001

Co-Principal Investigator

Dr. Abhishek Saxena

Associate Professor

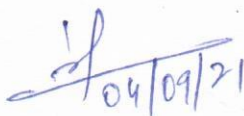
Department of Mechanical Engineering

Moradabad Institute of Technology

Moradabad-244001

Moradabad Institute of Technology

Ram Ganga Vihar, Phase-2, Moradabad - 244001



Dr. Munish Chhabra

Professor & Head

Deptt. of Mechanical Engg.

Moradabad Institute of Technology

Moradabad - 244001

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[Signature]
04/09/21

Dr. Munish Chhabra
Professor & Head
Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

(11)

Audited by Chartered Accountant in case private institution and by finance / Account officer in respect of Government / Government aided institution

**REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE
STATEMENT OF EXPENDITURE UNDER VISVESVARAYA
RESEARCH PROMOTION SCHEME**

1. Sanction Order No and date: Dr. APJAKTU/Dean-PGSR/2017/4236-46
Date: 09-08-2018)

2. Total Project Cost: Rs. 480,000/-

3. Revised Project Cost: Rs. 480,000/-
(if applicable)

4. Date of Commencement: 21-09-2017

5. Statement of Expenditure:

(Month wise expenditure incurred during current financial year)

Month & Year	Expenditure incurred / committed
November, 2017	4421
March, 2018	82298
May, 2018	105075
June, 2018	2258
July, 2018	133340
September, 2018	625
Total	328017/-

6. Grant received in each year:

(a) 1st Year : Rs. 440,000/-

(b) 2nd Year : NIL

(c) Interest, if any : NIL

Total (a+b+C) : Rs. 440,000/-

Nitin Agarwal
06-10-2018

Dr. Nitin Agarwal
Professor

Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

Munish Chhabra
04/09/21

Dr. Munish Chhabra
Professor & Head

Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

Statement of Expenditure

Sr No (I)	Sanctioned Heads (II)	Funds Allocated (indicate sanctioned or revised (III)	Expenditure Incurred		Total (VI)= IV+V	Balance as on (date) (VII) = III - VI	Requirement of Funds for next year	Remarks (if any)
			1 st Year (IV)	2 nd Year (V)				
1.	Manpower costs	--	--	--	--	--	2500	--
2.	Consumables	40000	7604	--	7604	32396	25000	--
3.	Travel	--	--	--	--	--	2500	--
4.	Contingencies	--	--	--	--	--	10000	--
5.	Others, if any	--	--	--	--	--	--	--
	Recurring Expenditure	40000	--	--	--	--	40000	--
6.	Non-Recurring Expenditure (Equipment)	400000	320413	--	320413	79587	--	--
7.	Total	440000	328017	--	328017	111983	40000	--

Prof(Dr.) Nitin Agarwal

Name and Signature of Principal Investigator
Professor

Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

Date: 06-10-2018

Director
Prof. (Dr.) B. P. Singh
Moradabad Institute of Technology
Name & Signature of Head of the Institution
Moradabad (with seal)

Signature of Competent financial authority

Accounts Officer (with seal)
Moradabad Institute of Technology
Date: 06-10-18
Moradabad

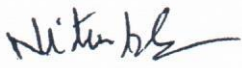
Dr. Munish Chhabra
Professor & Head
Deptt. of Mechanical Engg.
Moradabad Institute of Technology

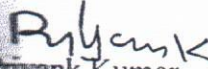
**Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh,
Lucknow**

Form of Utilization Certificate


Serial No. 4236-46 Letter No. Dr. APJAKTU/Dean-PGSR/2017/4236-46 Certified that out Rs. 440,000/- of Grant-in-aid sanctioned during the year 2017 infavour of Moradabad Institute of Technology, Moradabad under this office/Department letter no. Dr. APJAKTU/Dean-PGSR/2017/4236-46 given in the margin and Rs. NIL on account of unspent balance of the previous year, a sum of Rs. 328017/- has been utilized for the purpose of Research project titled "Performance enhancement of Solar PV System using Phase Change Materials and metallic fins." granted by Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow under Visvesvaraya Research Promotion Schemes-2017.

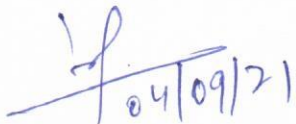
- Total for which it was sanctioned and that the balance of Rs. NIL remaining unutilized at the end of the year has been surrendered to AKTU (Vide no. NA, dated NA)
- Certified that I have satisfied myself that the condition of Visvesvaraya Research promotion Schemes, Seminar grant and travel grant on which the grant-in-aid was sanctioned have been duly fulfilled/ are being fulfilled and that I have exercised the checks necessary to see that the money was actually utilized for the purpose for which is was actually utilized for the purpose for which it was sanctioned,


Signature of Beneficiary
Designation *Professor* **Dr. Nitin Agarwal**
Date *15-10-2018* Professor
Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

For Priyank Kumar & Company
Chartered Accountants

Priyank Kumar
Membership No. 405557




Signature of Institute Director
Designation
Date *15-10-18*
Director
Moradabad Institute of Technology
Ram Ganga Vihar, Phase-2
Moradabad


Dr. Munish Chhabra
Professor & Head
Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

PROGRESS REPORT

VISVESVARAYA RESEARCH PROMOTION SCHEME

1. Project Title: Performance enhancement of Solar PV System using Phase Change Materials and metallic fins.	AKTU Ref:- DR. APARNA PGSR/2017/4234-45
2. PI (Name, Address, Phone, Fax, Email): Name: Dr. Nitin Agarwal Address: Professor Department of Mechanical Engineering Moradabad Institute of Technology Moradabad-244001 Phone: 9359397806 Email: nitin23757@gmail.com	Date of Birth: 14-11-1976
3. Co-PI (Name, Address, Phone, Fax, Email): Name: Dr. Abhishek Saxena Address: Associate Professor Department of Mechanical Engineering Moradabad Institute of Technology Moradabad-244001 Phone: 9837623458 Email: talk2abhi3@gmail.com	Date of Birth: 21-11-1979
4. Summary of Progress <ul style="list-style-type: none"> In this project a device will be attached with the solar panels to enhance its efficiency. Design of the device has been finalized and is the stage of manufacturing. Device will be manufacture before 30th November 2018 and thereafter experimental setup will be developed before 10th December 2018. Following research equipment have been purchased. <ul style="list-style-type: none"> (i) Infrared Thermal Image Camera (ii) Solar Power Radiation Meter (iii) 09 Solar Panels of 200 Wp (iv) Copper Sheets A review paper is in final stage of submission. Title of the paper is "Performance enhancement techniques of Photovoltaic systems" 	
Date of Start: 21/09/2017	Total cost of Project: 4,80,000/-
Date of completion: 21/09/2019	Expenditure as on 21/09/2018: 3,28,017/-
5. Objective of the Project: To investigate the use of phase change materials (PCMs) and metallic fins to maintain the temperature of solar panels close to the standard operating temperature at which a solar PV module produce maximum output in terms of electricity.	

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Dr. Munish Chhabra
 Professor & Head
 Deptt. of Mechanical Engg.
 Moradabad Institute of Technology
 Moradabad - 244001

6. Achievement:

In this project, a device will be designed and manufactured, which when attached with the solar panels will increase its efficiency. The design of the device has been finalized and is in the stage of manufacturing. The device will be taken to the level of patenting after testing its commercial feasibility.

7. Efforts done by PI on commercial application of the instrument:

As mentioned above, in this project a device consisting of metallic fins and phase change materials will be manufactured to increase the efficiency of solar panels. After experimentation efficiency enhancement of solar panels will be decided. Commercial feasibility of the device has been discussed with Prof. Lokesh Varshney (Professor, Department of Mechanical Engineering, GBPUAT, Pantnagar). The device will be taken to the level of patenting and thereafter its design will be made available for commercial applications through industries involved in manufacturing of solar panels.

8. Research work which remains to be done under the project (for on-going projects):

A device consisting of metallic fins and phase change materials will be manufactured to increase the efficiency of solar panels. The design of the device has been finalized and is in the stage of manufacturing. Different types of phase change materials will be tested for efficiency enhancement. After experimentation, most optimal fin geometry and phase change material will be selected for the device.

Ph.Ds Produced no:	Technical Personnel trained:	Research Publications arising out of the present project:
NIL	10	01(yet to be published)

List of Publications from this Project (including title, author(s), journals & year(s))

(A) Papers published only in cited Journals (SCI): NIL

(B) Papers published in Conference Proceedings, Popular Journals etc. NIL

Patents filed/ to be filed:

Solar Panel efficiency enhancement device (To be filed)

9. Major Equipment (Model and Make)

S.N.	Sanctioned List	Procured (Yes/ No) Model & make	Cost (Rs in lakhs)	Working (Yes/ No)	Utilisation Rate (%)
1	Solar panels with frames	Yes (Central Electronics Limited)	1.05075 Lakhs	Yes	100%
2	Solar power radiation meter(Pyranometer)	Yes Model: LPPYRA 03 Make: Deltaohm	0.4484 Lakhs	Yes	80%
3	Infrared Thermal image camera	Yes Model: TESTO 865 Make: TESTO	0.885 Lakhs	Yes	80%
4	Copper sheet	--	0.81998 Lakhs	Yes	70%

Dr. Munish Chhabra

Professor & Head

Deptt. of Mechanical Engg.

Moradabad Institute of Technology

Moradabad - 244001

Dr. Nitin Agarwal
Professor
Deptt. of Mechanical Engg
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