

**Programme Project Report (PPR)**  
**for**  
**Distance Learning Programme under School of Distance Education**

**Post Graduate Certificate in Nanoscience and Nanotechnology**  
**(PGCNN)**

**Course Co-ordinator: Dr. Nandakumar Kalarikkal**

*Academic support by*

**International and Inter University center for Nanoscience and  
Nanotechnology (IIUCNN)  
Mahatma Gandhi University  
Kottayam, Kerala**

**POST GRADUATE CERTIFICATE IN NANOSCIENCE AND  
NANOTECHNOLOGY (PGCNN)  
(Distance Learning Programme - Certificate Programme)**

**Programme Project Report**

Mahatma Gandhi University started the School of Distance Education in 1989 with the vision of providing the opportunity for quality education to all realms of society. Since the beginning, thousands of students have availed themselves of this opportunity for higher education to a great extent throughout Kerala. Many students outside the State have also benefited from this. But after the new directions of the UGC in 2014, the University had stopped all the Off-Campus Centres of the School of Distance Education both inside and outside the State.

Now it is the new endeavour of the School to revamp its functioning by offering different types of Diploma and Certificate programmes very relevant to contemporary society, in addition to the conventional Graduate and Post Graduate programmes. This is being done with the academic and infrastructural support of the eminent Schools and Interdisciplinary Interuniversity Centres of the University. All these Schools/ Centres have already conducted similar Programmes or Post Graduate Programmes in the same area. This Certificate Programme has been designed by the International and Inter University center for Nanoscience and Nanotechnology and is to be conducted by the School of Distance Education with the academic support of the Centre.

The Centre for Nanoscience and Nanotechnology was established as a nodal research centre of Mahatma Gandhi University in the year 2009. The Centre focus on the enhancement of research and higher studies in the cutting edge areas of nanoscience and nanotechnology. Considering the achievements in its academic and research pursuits in the past years since its inception, the state Govt. of Kerala has elevated the status of the Centre to International and Inter University Centre for Nanoscience and Nanotechnology (IIUCNN) in the year 2013. The Centre is motivated to thrust its research and development focusing on developing novel materials and devices prospering the outrage of nanoscience. The Centre also take up the social, ethical, legal and environmental issues related to nanoscience and nanotechnology. Thus, IIUCNN intends to act as a prime point to provide training and research in various interdisciplinary areas.

**a) Programme's mission & objectives :**

The aim of the certificate course Nanoscience and Nanotechnology through distance learning programme is to prepare students to become experts and develop skills towards doctoral studies, and/or professional industrial careers in synthesis, characterization of applications of nanostructured materials and composites . This module will provide the student with an understanding various strategies involved synthesis of nanomaterials. their characterizations and potential applications

**b) Relevance of the program with HEI's Mission and Goals :**

The programme focuses on state-of-the-art developments in their practices and instrumentation, as well as issues to deal with nanostructured materials. This programme places a strong emphasis on the professional development of the students. Such a qualification will enable and facilitate career progression for the students.

**c) Nature of prospective target group of learners:**

Students with science background (Bachelor degree holders) can join for the programme. Students doing their Masters/M.Phil/Doctoral studies can also join the programme to strengthen their analytical skills. Working professionals in government and private sector companies can also pursue this programme

**d) Appropriateness of programme to be conducted in Open and Distance Learning mode to acquire specific skills and competence :**

This course places a strong emphasis on the professional development of the students. Such a qualification will enable and facilitate career progression for the students. On successful completion of this module, a student will be able to (i) Understand the basics of Nanoscience and Nanotechnology (ii) to synthesize nanoparticles with different morphologies (iii) to characterize the above nanoparticles using various analytical techniques and (iv) to apply these nanoparticles in day to day applications

**e) Instructional Design :**

The course is of 6 months which includes theory and practicals. Study materials will be given by online. Test papers and assignments are also online. 20% of the practicals is by virtual lab.

Structure of the Course

Duration	:	6 months
Credits	:	16
Contact Hours - Theory	:	36 hrs
Contact Hours - Practical	:	120 hrs (20% by virtual lab.)

Course Code	Course Type	Course Name	Contact Sessions (Hours)	Credits	Internal Marks	External Marks	Total Marks
SDE-SCS-1	Common Core course (Theory)	Introduction to Nanoscience and Nanotechnology	12	4	20	80	100
SDE-SCS-2	Common Core course (Theory)	Strategies for synthesis of Nanomaterials	12	4	20	80	100
SDE-SCS-3	Common Core course (Theory)	Characterization of Nanostructured materials	12	4	20	80	100
SDE-SCS-4	Common Core course (Practical/ Project)	Synthesis, Characterization and application of Nanoparticles	*96	4	20	80	100
<b>Total</b>			<b>132</b>	<b>16</b>	<b>80</b>	<b>320</b>	<b>400</b>

\*(20% by virtual lab.)

### Course Design

For practicals, 20% will be virtual and remaining will be by direct laboratory work. This course will have three types of graded activities that will be included in overall course grade. These include: **Assignments:** Answer monthly quizzes that account for 20% of the course total grade. Each quiz includes 20 multiple choice questions that examines your understanding of the learning materials. **Open-ended Questions:** Answer two open-ended questions that account for 80% of the course total grade. The questions encourage creative thinking, and their answers are based on the knowledge gained in the course. **Final project:** At the end of the course the candidate will be asked to complete a final project. It will consist of a written report that focuses on the utilization of analytical techniques for various applications. The final project will be graded and will contribute to 25%.

#### f) Procedure for admissions, curriculum transaction and evaluation:

Admission to the programme will be done by the University through a common procedure for all the programmes under the School of Distance Education. Any student with minimum Bachelor degree in science can apply. Fee structure will be decided by the University. The course contents will be delivered online and in print form. The School will prepare an academic calendar/activity planner and will be circulated among all the learners at the time of admission itself. The academic calendar will include all the significant activities, important dates, schedule of submission of assignments, schedule of contact classes, schedule of examinations, etc.

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**Grading System** will be followed for the evaluation on a ten point scale. The details of the grading system are given in the following Table.

**Percentage Equivalence of Grade:**

Range of % of Marks	Grade Letter	Performance	Grade Point
95 - ≤ 100	O	Outstanding	10
85 - < 95	A plus	Excellent	9
75 - < 85	A only	Very Good	8
65 - < 75	B plus	Good	7
55 - < 65	B only	Above Average	6
45 - < 55	C	Average	5
40 - < 45	P	Pass	4
< 40	F	Fail	0
Absent	Ab	Absent	0

‘P’ grade is required for a minimum pass in a course. The minimum GPA required for a pass in the Certificate programme is 4.

**Calculation of Grade Point Average (GPA) :**

**Credit Points for the Course** = (No. of Credits assigned for the course x Grade Point secured for that course).

**GPA** indicates the performance of a student in the programme. GPA is based on the total **credit points** earned by a student in all the courses divided by the total number of credits assigned to the courses required in the programme.

Note: GPA is computed only if the candidate passes in all the required courses (gets a minimum required grade for a pass in all the required courses as per the curriculum).

$$\text{GPA} = \frac{\text{Total credit points earned by the student from all the required courses of the programme}}{\text{Total credits of all courses required in the programme}}$$

This formula shall be printed on the Grade Card issued to the student with a note that it could be used to convert the grades into mark-percentages. (The details of the grading system as indicated above shall also be printed on the Grade Card).

**Conversion of GPA to Grade**

<b>GPA</b>	<b>Grade</b>
10	O
9.0 - < 10	A plus
8.0 - < 9	A only
7.0 - < 8	B plus
6.0 - < 7	B only
5.0 - < 6	C
4.0 - < 5	P
< 4	F
Absent	Ab

**Conversion of GPA to percentage**

**Equivalent Percentage = (GPA obtained) X 10**

**g) Requirement of the laboratory support and Library Resources:**

To handle the practical components in syllabus, technicians and consumables are required. The laboratory facility of the centre shall be provided to the ODL students on holidays and vacation days. Certain level of the practical would be conducted and performed by applying virtual reality methods.

Mahatma Gandhi University Library and Information System consists of University Library, libraries of the Schools and 4 study centre Libraries. The University Library was established in 1989. The University Library which is situated in the main campus occupies purpose-built accommodation, and provides a variety of facilities and has a user-friendly environment. These include individual work spaces, room for group study and teaching, audio-visual access and online information retrieval system. The building of the University Library is 2000 sq.m in area consisting of the cellar, the ground floor and the first floor.

Academic as well as public users are given the facility to use the library. Special category membership is provided to journalists. The library is providing service from 8 am to 8 pm in three shift timings for its staff. The library functions on an average of 345 days in a year. The libraries of teaching departments are open during working hours of the Schools. Reading space is provided in all the three floors housing the various sections of the library. The library provides reading facility to the visually impaired users too. For this, an electronic lab custom made for visually and physically challenged users has been set up during 2016.

The library has a collection of 59,000 books, 232 journals, 2,135 Ph.D. theses and has access to 15000+ e-journals under E-Shodh Sindhu. The activities of the Library are comprehensively automated using open source library management software KOHA. OPAC, Journal Article Index, By monthly Bibliography compilation and Literature Search Service are also available

The library is a member of the INFLIBNET Centre, Ahmedabad as well as DELNET (Developing Library Network). As a member of these networks, the library provides access to the resources of other major libraries in the country. In addition to the access to UGC INFONET consortium, it has access to major online databases, such as EBSCO, ProQuest

dissertations and theses, Oxford Scholarship Online, IEEE All Society Periodicals Package etc. Mahatma Gandhi University had won the State IT Award during the year 2009 in the e-learning category for its university online theses digital library. The various department libraries have a good collection of subject specific books and journals.

<b>A. MAHATMA GANDHI UNIVERSITY LIBRARY</b>	
<b>Category</b>	<b>No.</b>
Books	59000
Journals	232
Bound Journals	7500
Ph.D Theses	2135
E-Journals (in UGC-Infonet, renamed as E-ShodhSindhu)	15000
Online databases (in UGC Infonet)	11
Online Archives subscribed	185 Titles
Online databases subscribed	4
E-books	7338
DVDs: Educational Videos	293

<b>B</b>	<b>Name of School/Centre</b>	<b>Total No. of books</b>
	International and Inter University Centre for Nanoscience and Nanotechnology	268

**h) Cost estimate of the programme and the provisions:**

The budget details for the course is given in the following Table.

**Budget Estimate**

<b>S. No.</b>	<b>Item</b>	<b>Amount (Lakhs)</b>
1	Staff salary teaching /Non-Teaching	5
2	Online study materials	2
3	Online virtual lab.	3
4	Online quizzes/assignments/evaluation	2
5	Laboratory demonstrations	3
6	Contact class arrangements	1
7	Examination	1
	<b>TOTAL</b>	<b>17 Lakhs</b>

**Total Programme fee: Rs.17500/-**

**i) Quality assurance mechanism and expected programme outcomes:**

The quality of the programme will be ensured through strict monitoring by an executive committee that includes the Co-ordinator of the programme, subject experts, Director, School of Distance Education and Head of the International and Inter University center for Nanoscience and Nanotechnology (IIUCNN). The Co-ordinator of the programme shall ensure regular student feedback of courses, teachers and the programme in the prescribed format towards the end of the semester and the same shall be analysed to draw conclusions for effecting improvement. Periodical review meetings on the programme's efficacy will be held, in which the remarks of teachers on curriculum, syllabi and methods of teaching and evaluation will be given due importance. Moreover, the progress and the quality of the programme will be monitored by the Internal Quality Assurance Cell of the University from the outcome and feedback of the learners as well as the proper documentation maintained in the Centre.

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## Syllabus

### **Post Graduate Certificate in Nanoscience and Nanotechnology (PGCNN)**

#### **Month 1:**

Introduction to nanotechnology and nanomaterials, how it all began: synthesis of carbon buckyballs, list of stable carbon allotropes extended, fullerenes, metallofullerenes, solid C<sub>60</sub>, bucky onions, nanotubes, nanocones, properties of individual nanoparticles, methods of synthesis for carbon nanostructures, carbon nanofilaments.

#### **Month 2:**

Synthesis Procedures of Nanomaterials (7h) Bottom-up vs. top-down, epitaxial growth, self-assembly, modeling and applications production techniques of nano-tubes carbon arc bulk synthesis in presence and absence of catalysts high purity material (bucky paper) production using pulsed laser vaporization (PLV) of pure and doped graphite high-pressure CO conversion (HIPCO) nano-tube synthesis based on boudoir reaction chemical vapor deposition (CVD)

#### **Month 3:**

Characterizations of Nanomaterials (7h) Optical microscopy, electron microscopy, secondary electron scattering, back scattering, scanning probe microscopes, focused ion beam technique, X-ray diffraction, SPM-AFM, STM, optical, electronic and vibrational spectroscopic tools etc..

#### **Month 4:**

Polymer Nanocomposites and Processing (7h) Polymer nano-composites: definitions, incorporation of nanomaterials in polymer matrix: interface, why nanomaterials, methods of preparation of polymer nanocomposites, nanoparticle dispersion and reinforcement by surface modification, surface modification of carbon nanofibers, compounding of layered silicate nano composites, nanoparticles in rubber processing, nanopolymers by microemulsion, Nanotechnology and tissue engineering.

#### **Month 5:**

Nanomaterials for Polymer Nanocomposites (7h ) Classification of nanoparticles, layered nanoparticles (Clay), fibrillar nanoparticles (carbon nanotubes (CNTs) etc.) and other nanoparticles, polymer clay nano-composites (PCNC), preparation steps - intercalation, exfoliation & functional CPNC, PNC with CNTs for electrical conductivity, PNC with CNTs - thermoset matrix and CNTs - thermoplastic matrix, comparison of PNC with normal composites based on composition, mechanical, thermal, rheology, morphology & process parameters.

## **Month 6:**

Properties of Nanomaterials (7h ) 36 Rheology of polymeric nanocomposites, VGCF and its alignment, nanocomposites of liquid crystalline polymers. Characterization of polymer nanocomposites: TEM and related techniques, mechanical properties of nanocomposites, mass transport through polymer nanocomposites, flammability properties, electrical properties, Thermal conductivity, Electro spun nanofibers.

### **Reference Books:**

1. Nanotechnology and Tissue Engineering: The Scaffold, Ed. Cato T. Laurencin, Lakshmi S. Nair, CRC Press, 2008.
2. Synthesis and Characterization of Nanopolymers by Microemulsion, Uttam Kumar Mandal, Pallavi Bhardwaj, Saroj Aggarwal, LAP Lambert Academic Publishing, 2012.
3. Rubber-Clay Nanocomposites: Science, Technology, and Applications Ed. Maurizio Galimberti, John Wiley & Sons, 2011.
4. Introduction to Nano Science, (CRC Press of Taylor and Francis Group LLC), G. Louis Hornyak, Joydeep Dutta, Harry F. Tibbals and Anil K. Rao, May 2008, 856pp, ISBN-13: 978142004805
5. Ashby, Michael F., Ferreira, Paulo J., Schodek, Daniel L. 2009. Nanomaterials and nanotechnologies: An overview. In: Nanomaterials, Nanotechnologies and Design, Linacre Haus, Jordan Hill, Oxford, 2009.
6. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay, A.N. Banerjee, PHI Learning Private Limited.
7. Applied Colloid and Surface Chemistry, Richard M. Pashley and Marilyn E. Karaman, John Wiley & Sons Ltd, 2004.
8. Nanostructuring Operations in Nanoscale Science and Engineering, Kal Renganathan Sharma, The McGraw-Hill Companies, Inc. ISBN: 978-0-07-162609-5, 2010.