Department of Nanoscience and Technology

Revised Syllabus of Diploma Programme (UG)

Program Objectives

1) To develop laboratory skills of students as per industrial requirement.
2) To enhance the technical knowledge of students.
3) To increase the employability opportunities for the students.
4) To promote entrepreneurship skills among the students.

Program Outcomes:

After successful completion of this Diploma Program students will be able to

1) Develop technical skills required for Nanotechnology based industries.
2) Understand the product development in nanotechnology.
3) Demonstrate the ability for product management.
4) Develop entrepreneurial skills.

III Year Diploma Program

1. Title: Industrial Nanotechnology
2. Year of Implementation: 2022-23
3. Duration: One Year
4. Pattern: Semester
5. Medium of Instruction: English
6. Contact hours: 7 hours/week
8. Structure of Course:

Syllabus Structure (UG)

Year	Semester	Course No.	Course Code	Contact Hours	Credits (1Credit=15 H)	Total Marks
1	I	CT I	DNTT 101	30	2	75
		CL I	DNTL101	60	2	75
	II	CT II	DNTT 202	30	2	75
		CL II	DNTL202	60	2	75
	Annual	CP I	DNTP101	30	1	50
			Total	**210**	**9**	**350**

Year	Semester	Course No.	Course Code	Contact Hours	Credits (1Credit=15 H)	Total Marks
2	III	CT III	DNTT 303	30	2	75
		CL III	DNTL303	60	2	75
	IV	CT IV	DNTT 404	30	2	75
		CL IV	DNTL404	60	2	75
	Annual	CP II	DNTP202	30	1	50
	Industrial and or Incubation and or Research and or Field Training			30	1	-
		Total		**240**	**10**	**350**
	V	CT V	DNTT 505	30	2	75
		CLV	DNTL505	60	2	75
	VI	CT VI	DNTT 606	30	2	75
		CL VI	DNTL606	60	2	75
	Annual	CP III	DNTP303	60	2	100
	Industrial and or Incubation and or Research and or Field Training			30	1	-
	Total			**270**	**11**	**400**
Total				**720**	**30**	**1100**

C: Course, T: Theory, L: Lab (Practical), P: Project

Total No. of Courses: 15 (Theory: 06, Practical: 06, Project: 03)

Theory and Practical: Semester, Project: Annual

Semester III

DNTT 505: Industrial Nanocoating methods

(Contact Hrs: 30 Credits: 2)

Learning Objectives: Student will have:

1. Industrial production skill of nanomaterials
2. Understanding of mechanism of industrial process of nanotechnology based products .
3. knowledge of nanomaterial coating techniques.

Unit I: (15)

Industrial Coating Process

Introduction to Nanocoating, Future for Nanocoating industries, Plasma Layer deposition, Physical Vapor deposition, atomic layer deposition, Chemical Vapor deposition, Sputtering, Anodization, powder coating, spray coating.

Unit II: Efficiency of industrially coated material (15)

Measuring efficiency of thin film, endurance of material, temperature dependance endurance, voltage dependent efficiency, study of hydrophobicity and hydrophilicity of thin film, contact angle, effect of surface tension.

Learning Outcomes:After completion of this course student will be able to

1. Explain nanocoating method
2. Understand techniques of nanomaterial coating process.
3. Analyse endurance of materials for industrial application
4. Determine property of coated material.

Reference Books:

1. Chemical Sensors and Biosensors ,Eggins R Brian, (Wiley, New York, Chichester, 2002)
2. Biosesnor: A Practical approach Cooper. J & Tass.C (Oxford: Oxford University Press, 2004)
3. Nanomaterials for Biosesnor Kumar. C. (Wiley – VCH , 2007)
4. Smart Biosensor technology, Knoff. G.K, Bassi. A.K, (New York: CRC Press, 2006)

Method used for teaching	CO1	CO2	CO3	CO4
Lecture	Y	Y	Y	Y
Presentation	Y	Y	N	N
Demonstrate	N	N	Y	Y
Group discussion	N	N	Y	N
Hands on training	Y	N	N	N
Problem solving	N	N	Y	Y

DNTL 505: **Practical (Contact Hrs: 60 Credits: 02)**

Learning Objectives:Students will have

1) Understanding of thin film deposition methodws
2) Knowledge of Optical properties of thin films.

3) Ability to analyse Electrical properties of thin films.
4) Understanding of calibration of sensor.

List of Practical's (15)

1. Study of physical vapor deposition
2. Study of plasma layer deposition
3. Study of Chemical vapor deposition
4. Study of Atomic layer deposition
5. Doctor blades technique for the deposition of thin film.
6. Synthesis of iron oxide film using spray pyrolysis technique
7. Synthesis of tin oxide film using spray pyrolysis technique.
8. Synthesis of copper oxide film using spray pyrolysis technique.
9. Electrical Endurance checking for iron oxide thin film
10. Electrical Endurance checking for tin oxide thin film
11. Electrical Endurance checking for copper oxide thin film
12. Conductivity measurement using four probe method
13. Resistive measurement using four probe method
14. Contact angle measurement.
15. Thickness of thin film.

Learning Outcomes:

After completion of the practical, Student will be able to

1) Get technical knowledge of thin films synthesis in industry
2) Develop skill for measuring physical, optical and electrical properties of thin film.
3) Calculate endurance of thin film
4) Measure and analyse contact angle of thin films.
5) Calibrate sensors for industrial application.

Method used for teaching	CO1	CO2	CO3	CO4	CO5
Lecture	Y	Y	Y	Y	N
Presentation	Y	Y	N	N	N
Demonstrate	N	N	Y	Y	Y
Group discussion	Y	Y	N	N	N
Hands on training	N	N	Y	Y	Y
Problem solving	N	N	Y	Y	Y

Reference Books:

1. A Laboratory Course in Nanoscience and Nanotechnology,Dr. Eddy Gerrard , Poinern Jai
(New York: CRC Press, Taylor and Francis Group, 2015)

Semester IV

DNTT 606: Application of Nano-coatings
(Contact Hrs: 30 Credits: 2)

Learning Objectives:
Students will have

1. Knowledge of Industrial production skill on nano- particles
2. Understanding of Industrial application nano materials in food industry
3. Knowledge of agriculture application of nanomaterials .
4. Knowledge of role of coating in textile industry .

Unit I: Nanotechnology in Agriculture and Food Industry: (15)

Nanotechnology in agriculture, Insecticides using nanotechnology, Nano fertilizers Nanotechnology in food industry, Contaminant detection and smart packaging, Food safety and biosecurity, Contaminant detection and smart packaging.

Unit II: Nanotechnology in Textiles Industry: (15)

Nano-fibre production –electrospinning, controlling morphologies of nanofibers, Multifunctional polymer nanocomposites, Carbon nanotubes and nanocomposites, Nano finishing in textiles (UV resistant, antibacterial,) hydrophilic, self-cleaning, flame retardant finishes.

Learning Outcomes:

Unit I: After completion of the unit, Student will be able to

1. Explain nanotechnology application in Agriculture & Food Industry
2. Identify thrust area of work, and will find out the solution with help of Nanoscience
3. Will learn efficiency of nanoparticles and their large-scale production system
4. Coat antibacterial material on cotton by applying various methods

Reference Books:

1. Nanotechnology in Agriculture and Food Science ,Axelos, Marcel H, Van de Voorde, (Wiley- VCH Verlag GmbH & Co. 2017)
2. Nanotechnology in Sustainable Agriculture, Verma.S, kumari. B, (US: CRC, Press, 2021)
3. Nanotechnology for food, Agriculture and Environment ,Ram Prasad, Jeyabalan Sangeetha, (Springer, chem, 2020)
4. Nanotechnology in Textiles ,Mishra. R, Militiky. J, (Woodhead Publishing Elsevier, 2018

Method used for teaching	CO1	CO2	CO3	CO4
Lecture	Y	Y	Y	Y
Presentation	Y	Y	N	N
Demonstrate	N	N	Y	Y
Group discussion	N	N	Y	N

Hands on training	Y	N	N	N
Problem solving	N	N	Y	Y

DNTL606: **(Practical):**

(Contact Hours: 60 Credits: 02)

Learning Objectives: Student will have :

1. Knowledge of nanotechnology in Agriculture
2. Understanding of Nanomaterials in food Technology
3. Understanding Role of nanotechnology Green Coating
4. Understanding of Nano-fabrics and its properties

List of Practical's (15)

1. Synthesis of TiO_2 nanoparticles.
2. Synthesis of SiO_2 nanoparticles.
3. Study TiO_2, SiO_2 nanoparticles and its photosynthesis on plants
4. Synthesis of Nano fertilizers
5. Green Synthesis of ZnO, TiO_2 nanocomposite
6. Study of ZnO nanoparticles on Plants
7. Green Synthesis of Ag Nanoparticles
8. Ag Nanoparticle Coating for food packaging
9. Antimicrobial study of ZnO nanoparticles
10. Synthesis of Silver-Cellulose nanocomposites for antimicrobial coating
11. General Introduction of electrospinning
12. Synthesis of polypyrrolidone (PVP) nanofibers by electrospinning
13. Characterization of Nanofibers using SEM, TGA, BET
14. Synthesis of nanofibers TiO_2 composites
15. Synthesis of conducting nanofibers using Polyacrylonitrile (PAN)

Learning Outcomes:

After completion of the practical, Student will be able to

1. Understand Production on nano-fibers using electrospinning
2. Explain difference between conventional fertilizer and nonfertilizer
3. Synthesize Green nanoparticles and understand its application in Agriculture

Reference Books:

1. Nanomaterials for Food Application ,Rubio A.L, Sanz .M.M, (Elsevier, 2019)
2. Nanotechnology in Textiles ,R, Militiky. J, (Woodhead Publishing Elsevier, 2018)

Method used for teaching	CO1	CO2	CO3	CO4

Lecture	Y	Y	Y	Y
Presentation	Y	Y	N	N
Demonstrate	N	N	Y	Y
Group discussion	Y	Y	N	N
Hands on training	N	N	Y	Y
Problem solving	N	N	Y	Y

DNTP303-Project (Contact Hours: 60 Credits: 02)