Department of Physics

Revised Syllabus of Advanced Diploma Programme (PG)

Preamble:

Advanced Diploma in Material Science is two year integrated course for post graduate students. The students from Physics should learn new material characterization techniques.

In this Advanced Diploma Programme students will be able to understand material identification through various characterizations techniques like SEM/FE-SEM, TGA-DTA, Contact angle, Thickness measurement, Thermoelectric power (TEP) and resistivity measurement.

Program Objectives of the Course:

1. The students are expected to understand the characterization techniques.
2. It is expected to inspire and boost interest of the students towards research.
3. The candidate can develop research for society.

Program Outcomes:

1. Student should able to understand Morphological properties of material
2. Student should able to understand SEM/FE-SEM, TGA-DTA techniques
3. Student should able to understand Quantitative Analysis of material

Advanced Diploma Programme (II Year)

1. Title: Material Science
2. Year of Implementation: 2021
3. Duration: One Year
4. Pattern: Semester
5. Medium of Instruction: English
6. Contact hours: 7 hours/week
8. Structure of Course:

Syllabus Structure (PG)

Year	Semester	Course No.	Course Code	Contact Hours	Credits (1Credit=15 H)	Total Marks
2	III	CT III	ADPT 303	30	2	75
		CL III	ADPL303	60	2	150
	IV	CT IV	ADPT 404	30	2	75
		CL IV	ADPL404	60	2	150
	Annual	CP II	ADPP202	60	2	150
	Industrial and or Incubation and or Research and or Field Training			60	2	-
	Total			**270**	**12**	**600**
Total				**510**	**22**	**1200**

AD: Advanced Diploma, Departmental Code (P: Physics)
C: Course, T: Theory, L: Lab (Practical), P: Project
Total No. of Papers: 10 (Theory: 04, Practical: 04, Project: 02) Theory and Practical: Semester**,**
Project: Annual

Semester I

ADPT 303**:** Material Science

(Contact Hrs: 30 Credits: 2)

Learning Objectives:

Students will be able to

1. understand the TGA-DTA technique
2. study Contact angle and thickness measurement

Unit I: Thermogravimetric analysis and Differential thermal analysis (TGA-DTA) (15)

Instrumentation/Construction and principle of thermogravimetric analysis (TGA).Applications-dehydration, decomposition, desorption, and oxidation processes .Instrumentation/Construction and principle of differential thermal analysis (DTA). Advantages and applications.

Unit II: Contact angle and thickness measurement (15)

Introduction, Thermodynamics-hysteresis and dynamic contact angles, contact angle curvature, typical contact angles, control of contact angles, and methods for measurement of contact angle-The static sessile drop method, The pendant drop method, The dynamic sessile drop method, Dynamic Wilhelmy method, Single-fiber Wilhelmy method and Washburn's equation capillary rise method.

Need of the thickness measurement, gravimetric method, surface profilometer. Principle, construction and working of profilometer**.**

Learning Outcomes:

After completion of the unit, Student is able to

1. understand principle and working of TGA-DTA technique
2. determine the contact angle and thickness of given material

Reference Books:

1. Sulbha K Kulkarni, Nanotechnology: Principles and Practice, 3rd edition (2015)
2. W. Smykatz-Kloss, Differential Thermal Analysis Application and Results in Mineralogy, Springer-Verlag Berlin Heidelberg Publisher 1st edition (1974)

ADPL303: **(Practical):**

(Contact Hrs: 60 Credits: 02)

Learning Objectives:

Students will be able to

1. determine TGA-DTA of given sample
2. determine crystallite size using Scanning Electron Microscopy (SEM/FE-SEM)

List of Practical's (15)

1.To determine TGA-DTA of given ZnO powder
2. To determine TGA of given CuO powder
3. To determine TGA of given ZnFe2O4 powder
4. To determine TGA-DTA of given TiO2 powder
5. To determine TGA of given Fe2O4 powder.
6. To determine TGA of given MoS2 powder
7. To determine TGA of given powder sample.
8.To study the contact angles of TiO2 films.
9.To study the contact angles of NiO films.
10.To study the contact angles of aqueous solutions on super hydrophobic material.
11.To study the contact angles of non-aqueous solutions on super hydrophobic material.
12.To study the contact angles of given thin films.
13.To study the contact angles of given thik films.
14. To study the contact angles of Silica aerogel.
15. To study the contact angles of CuO films.

Learning Outcomes:

After completion of the unit, Student is able to

1. understand advantages and applications of TGA-DTA technique.
2. understand hydrophobic and hydrophilic nature of material.

Reference Books:

1. Sulbha K Kulkarni, Nanotechnology: Principles and Practice, 3rd edition (2015)
2. W. Smykatz-Kloss, Differential Thermal Analysis Application and Results in Mineralogy, Springer-Verlag Berlin Heidelberg Publisher 1st edition (1974)

Semester II

ADPT 404**:** Material Science

(Contact Hrs: 30 Credits: 2)

Learning Objectives:

Students will be able to

1. understand Thermoelectric power (TEP) and resistivity measurement
2. understand Scanning Electron Microscopy (SEM/FE-SEM)

Unit I: Thermoelectric power (TEP) and resistivity measurement (15)

Introduction, characteristics of thermoelectric effect, thermocouple, Seeback effect, Peltier effect, Thomson effect. Conductivity, resistivity measurement by using two probe and four probe method, applications and advantage.

Unit II: Scanning Electron Microscopy (SEM/FE-SEM) (15)

Introduction, principle and capacities, sample preparation, scanning process and image formation, detection of secondary electrons, detection of backscattered electrons, beam-injection analysis of semiconductors, FE-SEM.

Learning Outcomes:

After completion of the unit, Student is able to

1. understand TEP and resistivity technique
2. understand morphological study from SEM technique

Reference Books:

1. J. Blatt, Thermoelectric Power of Metals, Published by Springer US, 1st Edition (1976)
2. Ludwig Reimer, Scanning Electron Microscopy: Physics of Image Formation and Microanalysis, Published by Springer-Verlag Berlin Heidelberg, 2nd Edition (1998)

ADPL404: **(Practical):**
(Contact Hrs: 60 Credits: 02)

Learning Objectives:

Students will be able to

1. determine thickness of given samples
2. identify morphology of given samples using Scanning Electron Microscopy (SEM/FE-SEM)

List of Practical's (15)

1. To determine thermoelectric power of given ZnO films deposited on glass substrates.
2. To determine thermoelectric power of given ZnO films deposited on Alumina substrates.
3. To determine thermoelectric power of given CdO deposited on glass substrates.
4. To determine thermoelectric power of given CdO films deposited on Alumina substrates.
5. To determine thermoelectric power of given n-type semiconductor.
6. To determine thermoelectric power of given p-type semiconductor.
7. To determine the resistivity of given semiconductor.
8. Determine the thickness of CuO films deposited on glass substrates using gravimetric weight difference method.
9. Determine the thickness of CuO films deposited on stainless steel substrates using gravimetric

weight difference method.

10.Determine the thickness of MoS2 films deposited on stainless steel substrates using gravimetric weight difference method.

11.Determine the thickness of MoS2 films deposited on glass substrates using gravimetric weight difference method.

12.Determine the thickness of MoS2 films deposited on FTO substrates using gravimetric weight difference method.

13.Determine the thickness of given films using cross sectional SEM images.

14.To determine the particle size of given ferrite material using SEM images.

15.To study the identification of morphological properties of given thin films.

Learning Outcomes:

After completion of the unit, Student is able to

1. understand gravimetric weight difference method.
2. determine particle size of given material.

Reference Books:

1. J. Blatt, Thermoelectric Power of Metals, Published by Springer US, 1st Edition (1976)
2. Ludwig Reimer, Scanning Electron Microscopy: Physics of Image Formation and Microanalysis, Published by Springer-Verlag Berlin Heidelberg, 2nd Edition (1998)

ADPP202: Project
(Contact Hrs. 60, Credits: 2)

BOS Sub-Committee	Expert Committee
1. Dr. P.K. Pagare--Chairman	1. Dr. D. H. Bobade, C. T. Bora college, Shirur
2. Dr. S. G. Kolhe-Member	2. Mr. Shambhuraj Yadav (Electra Solar Energy Systems, Satara)