

UNIVERSITY OF MYSORE
Centre for Materials Science and Technology
Manasagangothri, Mysuru-570 006

Regulations and Syllabus
Ph. D. in MATERIAL SCIENCE



Chairman
Board of Studies in Materials Science
University of Mysore, Mysore

UNIVERSITY OF MYSORE
GUIDELINES AND REGULATIONS

LEADING TO
PH. D. IN MATERIAL SCIENCE

Programme Details

Name of the Department	Centre for Materials Science and Technology
Subject	Material Science
Faculty	Science and Technology
Name of the Programme	Ph. D.

Modalities for the Assessment of Marks for Ph.D. Course Work

Paper 1 : Research Methodology and Advanced Materials Science

In Paper – I, there will be three units of 16 hours each. The units are as follows:

Unit-I: Research Methodology

Unit-II : Advanced Materials Science

Unit-III: Materials characterization Techniques – Giving equal importance for all the branches of Science where materials are involved i.e., Physics, Chemistry and Biology

The units will be taught by the faculty members of the department. A student has to study all the three units during the course and appear for the written assessment test for 50 marks conducted by the Directorate of Research. The remaining 50 marks is distributed as follows: A student has to present one seminar and submit one assignment during the course work as far as the Paper I is concerned. SEMINAR WILL BE ASSESSED FOR 30 marks which will be of 30 minutes duration. Assignment will be given by all the teachers who are engaged in teaching the course work. Further, at the end of the course work average marks will be taken for seminar and assignments/ separately.



Paper – I

100 marks

50 marks

Three units as

Above for the

Written

Assessment test

50 marks

Seminar: 30 marks

Assignment: 20 marks

Paper 2: Review of Literature in the Area of Research

In Paper – II, a student has to present two seminars (I & II), one during 8th week and another during 15th week of the course. In seminars I, a student has to highlight his/her broad area of the research work and in seminar II the review of literature, objectives etc should be given. It is stated in the letter No: UOM/DOR/5Ph.D/2011-12 dated 26/08/2011 ((d) on page 2) that Department Council shall assess the students for paper – II in the area of research paper. Doctoral Committee members (Guide, Chairman of the department and two senior faculty members) shall assess the same.

Paper – II

100 marks

50 marks

Seminar Presentation and
Seminar Report – I

50 marks

Seminar Presentation and
Seminar Report - II

UNIT I:

RESEARCH METHODOLOGY

INTRODUCTION :Definition of Research, Qualities of Researcher, Components of Research problem, Various Steps in Scientific Research : Hypotheses, Research Purposes, Research Design, Literature searching

DESIGN AND PLANNING OF EXPERIMENTS, TIME SCHEDULING : Aims and Objectives, Expected outcome, Methodology to be adapted, planning of experiments for achieving the aims and objectives, Importance of reproducibility of research work.

DATA COLLECTION : Sources of Data : Primary Data, Secondary Data; Sampling Merits and Demerits of Experiments, Procedure and Control Observation, sampling errors – Type-I Error – Type-IIError.

STATISTICAL ANALYSIS AND FITTING OF DATA : Introduction to Statistics – Probability, Estimates of Means and Properties; Chi – Square Test, Association of Attributes –t-Test –Standard deviation – Co-efficient of variations. Correlation and Regression Analysis. Introduction to statistical packages, plotting of graphs

USING COMPUTERS IN RESEARCH: Literature survey using web, handing search engines
Preparing presentations: i) Research papers: Using word processing software – MS

Word/Latex/others, Drawing graphs and diagrams – Origin and others ii) Seminar presentations – Power point for oral and poster presentations

SCIENTIFIC WRITING : Structure and Components of Research Report, Types of Report: research papers, thesis., Research Project Reports, Pictures and Graphs, citation styles.

Reference:

1. “How to write and Publish” by Robert A. Day and Barbara Gastel, (Cambridge University Press).
2. “Survival skills for Scientists” by Federico Rosei and Tudor Johnson, (Imperial College Press).
3. “How to Research” by Loraine Blaxter, Christina Hughes and Malcolm Tight, (Viva Books).
4. “Probability and Statistics for Engineers and Scientists” by Sheldon Ross, (Elsevier Academic Press).
5. “The Craft of Scientific Writing” by Michael Alley, (Springer).
6. “A Student’s Guide to Methodology” by Peter Clough and Cathy Nutbrown, (Sage Publications).

UNIT II

Advanced Materials Science

Introduction

Materials and their classification

Thermodynamics and Statistical Mechanics

Thermal Equilibrium, (Zeroth Law of Thermodynamics), First Law of Thermodynamics, Isothermal Process, Adiabatic Process, Isobaric Process; Isochoric Process; Second Law of Thermodynamics, Entropy, Third Law of Thermodynamics, Statistical Mechanics, Statistical Equilibrium, Statistical definition of entropy, Gibbs Paradox, Statistical Thermodynamics, Maxwell-Boltzmann Distribution Law Maxwell – Boltzmann Distribution & Ideal Gas, Quantum Statistics, Phase Space, Fermi-Distribution Law, Electron Gas, Bose-Einstein Distribution Law.

Polymers

Polymer synthesis and structure-chain structure and configuration-Conformation of polymer chain. Macromolecular dynamics – structure of crystalline polymers, polymers in the liquid crystalline state, Glass, Rubber.

Nanomaterials and Nanoscience:

Introduction: Different types of nanomaterials- Inorganic Quantum well, Quantum wires and Quantum dots, Metal cluster, Metal oxide nanocrystals, Semiconductor nanocrystals, Assemblies

of Nanocrystals, Carbon based nanomaterials, Carbon nanotubes (SWCNT and MWCNT), and Graphene, Core shell structure of different materials.

Synthesis of Nanomaterials Techniques

Top down and Bottom up approaches, Solid states routes; mechanical mixing; grinding; solid solution techniques; Evaporation; precipitation; Top seeded solution growth; sol-gel techniques; high temperature solution; hydrothermal solvothermal methods; Melt methods-super cooling, Czechorlskii methods; Skull melting; Electrochemical deposition and electrochemical oxidation using two and three electro, Vapour phase methods, CVD; CVT; MBE; Plasma; Laser ablation. Biological synthesis; Electrochemistry; Multi-energy processing; Mechno-Chemical; Sono-Chemical; Photo-Chemical; and Bio-Chemical, Micelle and Reverse Micelle, Template based synthesis.

Applications of Nanotechnology in various fields:

Renewable energy, solar energy, hydrogen production and fuel cells
Biomedical science, medicine, diagnostics, pharma
Food science and Nutrition, Biotechnology
Environmental sciences

Composites and Nanocomposites : Classification of Composites, Raw Materials, Nanocomposites, their properties and application. Properties and applications. Matrix: Thermoplastics.

UNIT III

Materials characterization Techniques

Introduction: Physical and chemical properties, Macroscopic properties: Optical. Electrical, dielectric, magnetic, mechanical. Microscopic properties: chemical structure, composition, surface characterization.

Probing bulk and nano-structure – XRD, TEM, HRTEM, Neutron scattering.

Surface structure and topography – SEM, STM, LEED, AFM

Microstructure – UV – VIS, Raman, FTIR, Optical microscopy, small angle scattering, NMR

Optical spectroscopy: Luminescence spectroscopy (PL, TL), Fluorescence spectroscopy.

Phase changes. Crystalline and amorphous fractions – DSC(2)



Thermo-gravimetric methods – TGA, DTA(2)

Others: XPS, ESCA, Auger etc.

References

1. Springer Handbook of Crystal Growth; Eds: G.Dhanraj, K.Byrappa, V.Prasad, M.Dudley, Springer Verlag (2010).
2. Springer Handbook of Nanotechnology; Eds: BharathBhushan, Springer Verlag, 2nd Edition (2009).
3. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, CBS publishers & Distributors, Delhi, Sixth Edition, 1986.
4. Colin N. Banwell and Elaine M.McCash, Molecular Spectroscopy, Mcgraw-Hill College; 4 Sub edition (June 1, 1994), ISBN-10: 0077079760
5. Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, CRC Press, (2008)
6. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley & Sons (2008)
7. Elton N.Kaufmann, Characterization of Materials, Vol. 1, Wiley & Sons (2003)
8. R.A. Laudise, Growth of Single Crystals, Prentice Hall, (1973)
9. G. Dhanaraj, K.Byrappa, V.Prasad and M.Dudley (Eds), Springer Handbook of Crystal Growth, Springer- Verlag (2010)
10. Peter E.J. Flewitt and R.K. Wild, Physical Methods of Materials Characterization, 2nd Edition, Taylor & Francis (2003)

