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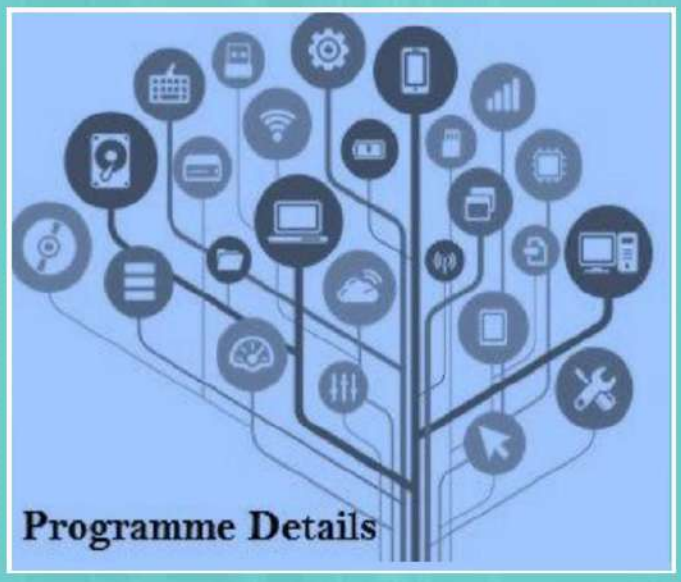
University of Mysore

(Estd.1916)

Ph. D. in Polymer Science



UNIVERSITY OF MYSORE

Department of Studies in Polymer Science
Sir M. Visvesvaraya Postgraduate Centre
Tubinakere, Mandya

Regulations and Syllabus

Ph.D IN POLYMER SCIENCE

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UNIVERSITY OF MYSORE

GUIDELINES AND REGULATIONS

LEADING TO

Ph D IN POLYMER SCIENCE

Programme Details

Name of the Department	:	Department of Studies in Polymer Science
Subject	:	Polymer Science
Faculty	:	Science and Technology
Name of the Programme	:	Ph. D. in Polymer Science

Programme Outcome

After completing this course, the students will be able to:

- Find a relevant topic for the Ph.D Dissertation.
- Formulate ideas about the topic, and the students arrive at sound decisions for making the right choice about future Ph.D topics in Polymer science.
- Provide students with a background that will prepare them to carry out an original investigation leading to an acceptable contribution to the body of contemporary knowledge in the fields of macro-molecules.
- Prepare the students ready for research work.

COURSE – I: RESEARCH METHODOLOGY

Course Outcomes

After the completion of this course the students will be able to

- Equipped with skills for global research enabling them to adapt, innovate and apply their knowledge to international aspects
- Integrate the global perspectives on aspects of macromolecules with a comparative approach to research in the field

Pedagogy

- The Course work format will combine lecture, discussions, seminar, and tutorials with a primary focus on skill development for a good research.
- Students are expected to prepare for and participate in discussion.
- Students are expected to review the delineated course materials in advance through

presentations.

- Assignments will be given to students which is to be submitted in a specified time and they will present their thoughts on the materials and methods going to employ in there research. Thorough discussions will be held on the topics

COURSE CONTENT:

Unit 1: General - Introduction to polymers with emphasis on important concepts such as - monomer, functionality and physical state (amorphous and crystalline), classification of polymers on the basis of source, elemental composition, heat, pressure, chemical reactivity, chemical/monomer composition, geometry and stereo regularity. Nomenclature of Polymers.

Unit 2. Chemistry and Mechanism of Polymerization - Definition of polymerization, factors affecting polymerization, Addition polymerization (free radical, ionic and co-ordination polymerizations), Condensation polymerization, Ring opening polymerization. Redox Polymerisation, Living radical polymerization,

Copolymerization – Co-polycondensation. Plasma polymerization, Photo polymerization, Electrochemical polymerization, Metathesis polymerization, Group transfer polymerization, ATRP, Reversible addition- fragmentation chain transfer polymerization, dendrimer.

Unit3. Specialty polymers- Functional polymers, LCP, Conducting polymers, degradable Polymers.

Engineering polymers: Unsaturated polyester resin, Epoxy resins, Phenolics, Amino resins, Alkyds. Properties and applications of engineering polymers: Nylons, Polyesters, PAN, PC, PU, ABS, Polyacrylates and allied polymers, Fluoropolymers, modification of industrial polymers.

Unit 4. Concept of polymer molecular weight: importance of molecular weight control. Arthemitic mean-molecular weight average Mw, Mn, and Mv. Molecular weight distribution and its importance from the point of applications.

Determination of molecular weight- End group analysis, cryoscopic method, ebulliometric metric methods, membrane osmometry, vapour phase osmometry, light scattering, ultracentrifugation &viscometry.

Unit 5.: Polymer Processing

Processing of Polymers: Moulding – compression moulding, injection moulding, blow moulding, rotational moulding, thermoforming. Extrusion – coextrusion, film extrusion, pultrusion, calendering, casting, coating.. Reaction Injection Moulding(RIM)- Principle and Application Structural reaction injection molding, resin transfer molding, foaming, laminates. Moulding of DMC and SMC and other thermoset processing operations.

Unit 6. Polymer Testing Mechanical properties :

Tensile properties, compression properties, flexural properties, shear properties, impact resistance, toughness, tear resistance, abrasion resistance and hardness.creep, stress relaxation, fatigue properties, flexing, and resilience

Flammability properties: oxygen index, critical temperature index, smoke density flammability test, ignition properties, and surface burning characteristics.
Electrical properties: insulation resistance, volume resistivity, surface resistivity, break down voltage, dielectric strength, arc Resistance, dielectric constant, power factor.
Optical properties: gloss, haze, refractive index, and degree of yellowness, transmittance, photoelectric properties, and color.
Miscellaneous properties: MFI, MVI, specific gravity, bulk density, ESCR, weathering properties, toxicity, resistance to chemicals, abrasion, tearing, Co-efficient of friction, VST, HDT, Nondestructive testing methods.

Unit 7.: Spectroscopic methods: **UV-Visible spectroscopy - Principle & theory** Applications- qualitative and quantitative analysis, purity, cis-trans-conformation, molecular weight determination, polymer degradation analysis.
Fourier transform infrared spectroscopy: principle & theory,
Applications – Establishment of chemical structure of polymers, reaction kinetics, polymer linkages, hydrogen bond formation, purity, copolymerization, qualitative and quantitative results.
Nuclear magnetic resonance: (^{1}H and ^{13}C NMR) principle, theory, applications-stucture (chemical), purity, tacticity, etc.

Unit 8.Thermal methods:
DSC: theory, principle & interpretations of DSC thermogram, Applications- heat of fusion and degree of crystalanity or isotacticity. Random copolymer structure. Block copolymer structure. Polymer mixture melting point depression by diluents, crystallization, meltcrystalisation, cold crystalisation. Tg, Tm, determination of blend composition,purity, identification of unknown, degree of crystallization, degree of cure, rate of cure studies (kinetics of curing) plasticizer effect, (Broido method, Kissinger method , Ozawa method, B&D method)
Thermogravimetric analysis: principle, theory, Applications- purity, fiber content, composition of copounded rubber, identification of polymers and rubbers, thermal stability, thermal degradation, kinetics of thermal degradation, IPDT, etc,
Principles of DMA and TMA-applications.

Unit 9.Chromatographic technique: Gel permeation chromatography- theory, principles, Applications- qualitative and quantitative analysis, molecular weight determination and molecular weight distribution, purity, composition, polymerization kinetics, depolymerization, identification of unknown, etc.
X-ray diffraction: SAXS, WAXS, theory, principle, Application- Chain conformation, chain packing, disorder in crystals, degree of crystalinity, microstructural parameters, degree of orientations.
Principles of optical microscopy, SEM, TEM, AFM. Applications - Morphology of polymers, crystalization behavior, phase separation.

Unit 10: Structure-property relationship
Polymer properties- Approach and the concept.Chemical structure of polymers – Introduction,

shapes and energy consideration, copolymers, heteroatomic polymers. Physical structure of polymers – introduction, melt viscosity, interchain and intrachain forces; glass transition temperature; crystallinity; elastomers, fibers, plastics and their correlation with Tg and Tm (structural features). Physical properties of polymers in relation to chemical structure: volumetric properties – volume and density, thermal expansion; calorimetric properties – heat capacity, enthalpy and entropy; transition temperatures – Tg, Tm, and relationship between Tg and Tm of polymers; solubility – the solubility parameter, solubility limits.

COURSE -II: REVIEW OF LITERATURE

Course Outcome

While there might be many reasons for conducting a literature review, following are four key outcomes of doing the review.

After the completion of this course the students will be able to have the following points

Assessment of the current state of research on a topic. This is probably the most obvious value of the literature review. Once a researcher has determined an area to work with for a research project, a search of relevant information sources will help determine what is already known about the topic and how extensively the topic has already been researched.

Identification of the experts on a particular topic. One of the additional benefits derived from doing the literature review is that it will quickly reveal which researchers have written the most on a particular topic and are, therefore, probably the experts on the topic.

Identification of key questions about a topic that need further research. In many cases a researcher may discover new angles that need further exploration by reviewing what has already been written on a topic.

Determination of methodologies used in past studies of the same or similar topics. It is often useful to review the types of studies that previous researchers have launched as a means of determining what approaches might be of most benefit in further developing a topic.

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