**Proposed Graduate Program of** Student Name:ID Number:

Leading to the Degree of **Ph.D. in Macromolecular Science and Engineering**

**Research Courses:**

MACR 7994 Research and Dissertation – minimum 58 hours for Ph.D. candidates

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| Semester | Dept | Course No. | Course Title | Credit Hours | Grade |
| Fall 2023 | MACR | 7994 | Research and Thesis/Dissertation |  | EQ |
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|  |  |  | Subtotal |  |  |

**MACR Core Curriculum Courses (8 credit hours):**

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| Semester | Dept | Course No. | Course Title | Credit Hours | Grade |
|  | MACR | 5015 | Macromolecular Fundamentals with Lab I | 3 |  |
|  | MACR | 5016 | Macromolecular Fundamentals with Lab II | 3 |  |
|  | CHEM/CHE/MSE | 5014 | Technical Oral Communications | 1 |  |
|  | MACR | 5024 | Writing Skills for Macromol. Sci/Engr. | 1 |  |
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| *Subtotal* | | | | 8 |  |

**MACR Electives (6 credit hours):**

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| Semester | Dept | Course No. | Course Title | Credit Hours | Grade |
|  | MACR | 5004 | Graduate Seminar | 1 |  |
|  | MACR | 5004 | Graduate Seminar | 1 |  |
|  | MACR | 5004 | Graduate Seminar | 1 |  |
|  |  |  | Select one from list of MACR module courses\*\* | 3 |  |
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| *Subtotal* | | | | 6 |  |

\*\*select one of these modules courses that is NOT in your major module: CHEM 5705 - Syn Reac Macromolecules, PHYS 5564G - Advanced Polymer Physics, CHE 5204 - Applied Rheology, CHEM 5424G - Advanced Polysaccharide Chemistry

**MACR Modules Courses (9 credit hours):**

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| --- | --- | --- | --- | --- | --- |
| Semester | Dept | Course No. | Course Title | Credit Hours | Grade |
|  | CHEM | 5174 | Polymer Viscoelasticity | 3 |  |
|  | CHEM | 6664 | Polymer Morphology | 3 |  |
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| *Subtotal* | | | |  |  |

**General Elective Courses (9 credit hours):**

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| Semester | Dept | Course No. | Course Title | Credit Hours | Grade |
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| *Subtotal* | | | |  |  |

**Total Credit Hours:**

**MACR Courses**

All students must complete the MACR core curriculum courses. Ph.D. candidates must complete 6 credit hours of MACR electives, 9 credit hours of module courses and 9 credit hours of general electives.

Research Courses

MACR 7994 Research and Dissertation – minimum 58 hours for Ph.D. candidates

Synthesis Module

CHEM 4534 Organic Chemistry of Polymers

CHEM 5704 Synthesis of Macromolecules

CHEM 6564 Current Topics in Polymer Chemistry

CHE 5984 Interfacial Chemistry and Engineering

CHE 5984 Applied Rheology

CHEM 6664 Amorphous and Crystalline State of Polymers

SBIO 5424 Polysaccharide Chemistry

*Choice of:*

CHEM 5505 or 5506 Advanced Organic Chemistry

CHEM 5535 or 5536 Synthetic Organic Chemistry

CHEM 5524 Molecular Structure Determination

Structure Module

CHEM 6674/PHYS 5564G Physical Chemistry of Polymers

CHEM/ESM 5174 Polymer Viscoelasticity

CHEM 6664 Amorphous and Crystalline State of Polymers

CHE 5984 Soft Materials and Self-Assembly

CHE 5984 Dynamic Theory of Complex Fluids

MSE 5504 Polymer Deformation and Fracture

PHYS 4564/5564G Polymer Physics

Processing Module

CHE 4224/MSE 4524 Introduction to Polymer Processing

MSE 5504 Polymer Deformation and Fracture

CHE 5984 Dynamic Theory of Complex Fluids

ESM 5514 Viscous Flow

ESM/CHSE 5564 Non-Newtonian Fluid Mechanics

Mechanics Module

*Choice of:*

ESM 5734 Introduction to Finite Element Analysis

ESM 4044 Mechanics of Composite Materials

ESM 5014 Introduction to Continuum Mechanics

CHEM/ESM 5174 Polymer Viscoelasticity

ESM/CHE 5564 Non-Newtonian Fluid Mechanics

ESM 5114 Viscous Flow

ESM 6104 Mechanics of Composite Strength and Life

ESM 5074 Mechanics of Laminated Composite Structures

MSE 5504 Polymer Deformation and Fracture

Adhesion and Surface Science Module

CHEM/ESM/MSE 5654 Adhesion Science

CHEM/ESM 5174 Polymer Viscoelasticity

CHEM 5644/CHE 5334G Colloid and Surface Chemistry

CHEM 7764/PHYS 5564G Physical Chemistry of Polymers

ESM 5264 Mechanics of Adhesive Bonding

CHEM 5524 Molecular Structure Determination

CHE 5984 Interfacial Chemistry and Engineering

CHEM 6664 Amorphous and Crystalline State of Polymers

Materials in Medicine Module

BCHM 5124 Biochemistry for the Life Sciences

GRAD 5134 Polymers in Medicine and Biology

CHE 5214/BMES 5434 Polymeric Biomaterials

MSE/ESM 4574 Biomaterials

MSE 5584 Biomimetic Material Design

BMES 5984 Fundamentals of Tissue Function, Structure, and Replacement

BMES 5314 Introduction to Regenerative Medicine I

SBIO 5242 Polysaccharide Chemistry

*Choice of:*

CHEM 4534 Organic Chemistry of Polymers

CHEM 5704 Synthesis of Macromolecules

CHEM 6564 Advanced Macromolecular Chemistry

Composites and Structures Module

*Choice of:*

ESM 4044 Mechanics of Composite Materials

MSE 4604 Advanced Composite Materials

ESM 5074 Mechanics of Laminated Composite Structures

ESM 6014 Mechanics of Composite Strength and Life

CHEM/ESM 5174 Polymer Viscoelasticity

MSE 5504 Polymer Deformation and Fracture

Micro- and Opto-electronics Module

PHYS 5984 Opto-Electronic Properties of Polymers

*Choice of:*

CHEM 4534 Organic Chemistry of Polymers

CHEM 4224/MSE 4524 Introduction to Polymer Processing

MSE 4554 Polymer Engineering

*Choice of:*

EE 5144 Introduction to Electro-Optics

MSE 5214 Opto-Electronics/Magnetic Applications

PHYS 5614 Introduction to Quantum Electronics

**Advisory Committee:**

Chair: [Type NAME here] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Signature ID Number

Co-Chair (optional): [Type NAME here] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Committee Member: [Type NAME here] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Program Director: [Type Name here] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Signature of Candidate Date Submitted**

**\*\* For non-Virginia Tech committee members, please submit a Graduate Program Faculty & Additional Committee Member Registration form, found on the Graduate School’s website.**