

**4+1 BCHE/MEPT**

**I.** **Rationale for Creation, Revision or Deletion**

The Department of Chemical and Biomolecular Engineering is requesting to add a 4+1 program in ***Particle Technology*** to allow BCHE students to take 3 courses from the MEPT Core Courses and MEPT Approved Relative Elective Courses to meet their undergraduate degree requirements and graduate degree requirements, if the students applies and is admitted to the MEPT program.

***Background***:

The Department of Chemical and Biomolecular Engineering does not have a 4+1 program. A background study was completed, and no US institutions offer a graduate degree in particle technology. There is UD student interest and international industrial demand. The majority of products produced in the chemical, pharmaceutical, materials, consumer products and energy industries either include particles or are made through the agency of particles. Engineers who work in these industries will inevitably find themselves designing, scaling and troubleshooting processes or systems involving particles. Undergraduate engineering programs rarely address the unique issues introduced by the particle phase. While elements of powder processing may be introduced in chemical, mechanical or materials engineering curricula, no program provides a comprehensive background in the properties of granular systems or the design and analysis of particle products and processes.

The 4+1 program is intended for University of Delaware BCHE undergraduates who want to develop their expertise in particle technology for industrial application and, upon graduation, continue their Master in Engineering in Particle Technology, either full-time or part-time while working in industry.

***Requirements****:*

* A program GPA of 3.0 or higher in STEM undergraduate course prerequisites.
* Course prerequisites: undergraduate program included engineering thermodynamics, calculus, differential equations, and linear algebra, and transport phenomena (fluid mechanics, heat and mass transport).
* Admittance to the 4+1 program in the summer (preferably) before their junior year by the Director of Particle Technology.

***Objective****:* To prepare students to meet the processing industry expectations with respect to particle technology. It is anticipated that it will serve as a recruiting tool for the graduate program in Master of Engineering in Particle Technology.

**II.** **Rationale and Demand**

A. Institutional Factors

1. UD Mission Compatibility: Among the “milestones” mapped out in UD’s *Path to Prominence* were excellence in professional education and a global initiative that extends UD’s geographic reach. Through use of UDCapture and Sakai (and other media platforms), this 4+1 will be accessible to University of Delaware students while on campus during their undergraduate career and well beyond the Delaware region for completion of the MEPT graduate degree. To date, we have had students taking the core MEPT courses remotely from other areas of the country (more than one hour from campus).

2. Planning Process: Because the College of Engineering/Department of Chemical and Biomolecular Engineering recognized the gap in their graduate offerings, Dr. R. Bertrum Diemer and Dr. James N. Michaels were hired to start and direct the Master of Engineering in Particle Technology Program, the national need for which has been affirmed by research of existing national and international programs. Through initial research and input from Merck, DuPont, Dow, AbbVie, Procter and Gamble, Abbott, Unilever, Lilly, GlaxoSmithKline, Particle Science and DSM, appropriate courses were designated (with additional courses planned as options for the certificate program). [What about IFPRI support???]

3. Impact on other UD Programs: Program course requirements are all CHEG courses.

4. Utilization of Existing Resources: No additional resources are required at this point, as all courses are existing or planned and UDCapture is existing on-campus.

B. Student Demand: This 4+1 program is designed for engineering undergraduates who plan to be working in the process industries and desire to expand their knowledge of particle technology engineering. We anticipate an ongoing enrollment of BCHE undergrads.

C. Transferability: Three courses are transferable into the MEPT graduate engineering degree program, should the student decide to apply and is accepted into the MEPT graduate engineering degree program.

D. Graduate and Professional Program Access: MEPT courses are accessible to distance learners and part-time students. Online courses are anticipated in the near future.

E. Demand & Employment Factors: As our initial research study pointed out, there are no US institutions offering graduate degrees in particle technology engineering or a certificate program. Only one institution, the University of Western Ontario, offers a master’s degree in particle technology and fluidization. Several international schools have strong particle technology research programs, including TU Delft, University of Birmingham, University of Leeds, University of Queensland, U Pretoria and TU Braunschweig but none offer a coherent degree or concentration in particle technology.

F. Regional, State and National Factors: The process industry in US is flourishing, yet, despite the importance of particle processing and particle technology in industry, degree offerings in the field are limited, especially for post-baccalaureate students and practicing professionals. This 4+1 program can help fill the void.

G. Other Strengths: We already have anticipated collaborations with several corporations for our MEPT program. The addition of a 4+1 program will enhance our graduating BCHE engineers who would like to advance their careers, help meet their employers’ expectations for educational background in the particle processing industry and allow students to gain prospective faculty recommendations.

**III.** **Enrollments, Admissions and Student Finances**

Admissions and enrollment in particle technology courses will be managed by the Director(s) of Particle Technology Engineering. The prospective student is required to submit a copy of his/her undergraduate transcript for review (preferably) before their Junior year, and, upon approval by the Director(s), the student will be receive 4+1 approval and permission to enroll in MEPT graduate courses. This may result in three elective courses, taken while an undergraduate, included on their undergraduate transcript but also transferrable to their graduate transcript (making them applicable to the MEPT degree program if/when the student elects to apply and is accepted into the MEPT graduate engineering degree program).

**IV. Curriculum Specifics**

Program Description: The courses will be taken for credit with standard grading (A, B, etc.). Courses in which the student earns a grade of B or better would be transferable in a graduate degree program. At the University of Delaware, and most institutions, a maximum of three graduate courses (9 credits) taken during undergraduate status which are transferrable into a graduate degree program.

Professor R. Bertrum Diemer, Jr., and James N. Michaels will serve as the Directors of the Graduate Certificate in Particle Technology Engineering. This 4+1 program will be offered by the University of Delaware’s Department of Chemical and Biomolecular Engineering and will be administered through the MEPT Program. Satisfactory completion of the courses for matriculation into the MEPT graduate engineering degree program will require earning a GPA of 3.0 or higher.

MEPT Core Course Requirements eligible for 4+1: (*This list may be added to over time*.)

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| **Core Course No.** | **Course Name** | **Credits** | **Session** |
| CHEG670 | Particle Rate Processes | 3 | Fall Course |
| CHEG671 | Particle Transport | 3 | Fall Course |
| CHEG672 | Mathematics of Particle Systems | 3 | Fall Course / Future Online Course Option |
| CHEG673 | Particle Properties and Characterization | 3 | Fall Course |
| **Elective Course No.** | **Course Name** | **Credits** | **Session** |
| CHEG600/MSEG630 | Intro to Science & Eng of Polymer Systems | 3 | Fall Course |
| CHEG604 | Probability & Statistic for Eng Problem Solving | 3 | Spring Course |
| CHEG615 | Special Topics in Mixing | 3 | Spring Course |
| CHEG616/MSEG616 | Chemistry & Physics of Surfaces & Interfaces | 3 | Spring Course |
| CHEG617 | Colloid Science & Eng | 3 | Spring Course |

**V. Resources Available**

There are no special learning resources required to support this 4+1 program, other than the availability of UDCapture (or other media programs) and a learning management platform, both of which currently exist.

**VI. Resources Required**

Current resources (learning resources as well as faculty resources) are sufficient to support this 4+1 program.

**VII. Implementation and Evaluation**

In collaboration with the Engineering Outreach Program and the Department of Chemical and Biomolecular Engineering [what about IFPRI support], this 4+1 program will be marketed broadly, both nationally and internationally. Because of the anticipated part-time status of its clientele, the program will be administered by the Director(s) of Particle Technology, including admission, enrollment and advisement. Upon completion of three graduate courses with a GPA of 3.0 or higher, and application and admission to the MEPT Program, students may submit a transfer of credit of the three courses to the MEPT Program.

University course evaluations of the 4+1 program (which are part of the graduate curriculum in chemical engineering) will be reviewed by the Department of Chemical and Biomolecular Engineering. In addition, a follow-up survey will be conducted by the Engineering Outreach Program of those who complete the 4+1 program in an effort to assess the usefulness of the information provided for those in the particle processing industries. That feedback will be provided to the Director(s) of Particle Technology.