

# CHEMISTRY, B.S. - NANOTECHNOLOGY OPTION

The Chemistry Department at Millersville offers a B.S. Chemistry degree with an option in Nanotechnology. The curriculum includes courses that give students a strong background in chemistry and electives in nanotechnology and other sciences. As part of the current program, students spent a semester at Penn State University Park Campus to gain practical experience in nanofabrication and the use of clean room facilities. Nanotechnology - which is the control of materials at very small dimensions to make smaller, cheaper and better products is being adopted in many industries. Upon graduation students can pursue graduate studies in chemistry or materials sciences, or work in industry or government usually in an environment involving interaction with scientists from other disciplines such as biology, physics and engineering.

## Major in Chemistry, BS

| Code  | Title                                | Hours     |
|---|--------------------------------------|-----------|
| CHEM 188  | Freshman Seminar in Chemistry        | 1         |
| <b>100 AND 200 LEVEL CHEMISTRY REQUIRED COURSES</b>   |                                      |           |
| A grade of C or better is required in the 100/200 level courses before proceeding to the courses for which they are pre-requisites. |                                      |           |
| CHEM 111  | Introductory Chemistry 1 (C minimum) | 4         |
| CHEM 112  | Introductory Chemistry 2 (C minimum) | 4         |
| CHEM 231  | Organic Chemistry 1 (C minimum)      | 4         |
| CHEM 232  | Organic Chemistry 2 (C minimum)      | 4         |
| CHEM 251  | Inorganic Chemistry 1 (C minimum)    | 3         |
| CHEM 265  | Quantitative Analysis (C minimum)    | 4         |
| <b>300 AND 400 LEVEL CHEMISTRY REQUIRED COURSES</b>   |                                      |           |
| CHEM 341  | Physical Chemistry 1                 | 4         |
| CHEM 342  | Physical Chemistry 2                 | 4         |
| CHEM 487  | Seminar in Chemistry 1               | 0.5       |
| CHEM 488  | Seminar in Chemistry 2               | 0.5       |
| Independent Study - Choose 1 hour from:   |                                      | 1         |
| CHEM 498  | Independent Study                    |           |
| <b>CHEMISTRY OPTIONS</b>  |                                      |           |
| Option in Nanotechnology - See separate block   |                                      |           |
| <b>Total Hours</b>  |                                      | <b>34</b> |

## Option in Nanotechnology, Chemistry, BS

| Code                             | Title                       | Hours |
|----------------------------------|-----------------------------|-------|
| CHEM 312                         | Chemistry in Nanotechnology | 3     |
| Electives - Choose 4 hours from: |                             | 4     |
| CHEM 300                         | Co-Op Ed Experience in Chem |       |
| CHEM 326                         | Biochemistry 1              |       |
| CHEM 375                         | Environmental Chemistry     |       |
| CHEM 381                         | Polymer Chemistry 1         |       |
| CHEM 391                         | Advanced Laboratory 1       |       |
| CHEM 392                         | Advanced Laboratory 2       |       |
| CHEM 435                         | Advanced Organic Chemistry  |       |
| CHEM 452                         | Inorganic Chemistry         |       |
| CHEM 465                         | Analytical Chemistry        |       |

|          |                     |  |
|----------|---------------------|--|
| CHEM 486 | Topics in Chemistry |  |
| CHEM 489 | Honors Course       |  |
| CHEM 498 | Independent Study   |  |
| CHEM 499 | Departmental Honors |  |

## PROFESSIONAL BLOCK PENN STATE COURSES

Courses taken in a Capstone Semester at Penn State University in the Nanofabrication Facility.

|          |   |   |
|----------|---|---|
| NFMT 311 | Materials, Safety & Equipment Overview for Nanotechnology | 3 |
| NFMT 312 | Basic Nanotechnology Processes                            | 3 |
| NFMT 313 | Thin Film Utilization                                     | 3 |
| NFMT 314 | Lithography   | 3 |
| NFMT 315 | Materials Modification in Nanotechnology                  | 3 |
| NFMT 316 | Characterization, Testing Nanotech Structures & Materials | 3 |

**Total Hours** 25

## Req Related for Chemistry, BS

| Code   | Title                   | Hours        |
|--|-------------------------|--------------|
| <b>MATHEMATICS</b>   |                         |              |
| Calculus I or Honors Calculus - Choose 1 of the following: |                         | 4-5          |
| MATH 161   | Calculus 1              |              |
| MATH 163H  | Honors Calculus 1       |              |
| MATH 211   | Calculus 2              | 4            |
| MATH 311   | Calculus 3              | 4            |
| <b>PHYSICS</b>   |                         |              |
| PHYS 231   | Physics 1 with Calculus | 5            |
| PHYS 232   | Physics 2 with Calculus | 5            |
| <b>Total Hours</b>   |                         | <b>22-23</b> |

## American Chemical Society Certification - Optional

| Code   | Title | Hours |
|--|-------|-------|
| THIS BLOCK IS NOT REQUIRED FOR DEGREE COMPLETION. The following block contains courses which are required/recommended to students opting for ACS Certification. While not required, an introductory Economics course, elementary German or Russian (GERM/RUSS 101 and 102) are recommended for inclusion in the core Liberal Arts core requirements for general education. Students must take a minimum of two hours of CHEM 489, 498, or 499 (Research) under Chemistry Electives. This means you will need a total of 3 credits in CHEM 489, 498 or 499. |       |       |

| REQUIRED COURSES FOR ACS CERTIFICATION               |                       |   |
|--|-----------------------|---|
| CHEM 326   | Biochemistry 1        | 4 |
| CHEM 392   | Advanced Laboratory 2 | 1 |
| Required Independent Research - Choose 3 hours from: |                       | 3 |
| CHEM 489   | Honors Course         |   |
| CHEM 498   | Independent Study     |   |
| CHEM 499   | Departmental Honors   |   |

## RECOMMENDED COURSES FOR ACS CERTIFICATION

|  |          |
|--|----------|
| Introductory Economics - Optional Recommended                | 0        |
| Elementary Language German or Russian - Optional Recommended | 0        |
| <b>Total Hours</b>   | <b>8</b> |