



**FIVE YEAR COMBINED
BS-CHEMISTRY / MS-MATERIALS
PROGRAM**

Revised Summer 2015

BS CHEMISTRY/MS MATERIALS PROGRAM

CONTACT INFORMATION

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DCB= Department of Chemistry and Biochemistry

Important: *There will be an informational session for all students during the spring quarter of the sophomore year. Please notify your departmental undergraduate advisor of your interest in attending this session. If you are interested in joining the BS/MS program you must notify the Department of Chemistry and Biochemistry Undergraduate Office and the Materials Department Graduate Office of your interest after the informational session, but before the end of the spring quarter of your sophomore year, and arrange a meeting with Professor Seshadri, the Materials BS/MS Program Advisor for DCB to start planning your academic program. Students who do not comply with this requirement will find it difficult to join the program.*

Why should chemists be interested in materials science?

Materials Science and Engineering (MS&E) covers a broad and highly interdisciplinary area at the interface of physics, chemistry, life science, and engineering. The discipline addresses the development of new materials and the improvement of established materials for applications in technology and society that can range from the somewhat mundane (better ceramics cookware) to the very cutting-edge (new semiconductors for more efficient solar cells). Chemistry, oft touted as the “central science”, is central to MS&E as well. It is knowledge of the chemistry of metals and alloys, inorganic materials, polymers molecular organics that makes new materials accessible. Improved processing of existing materials also invariably involves knowledge of chemistry. An example of this is a development closely associated with UCSB researchers: of *p*- type gallium nitride, which critically involved not only an understanding of the chemistry of the element magnesium, but the gas-phase chemistry of hydrogen and its interaction with GaN as well. It is this development that has made available efficient white GaN-enabled solid state lighting. Some other examples in the development of new materials, again drawing from UCSB research, include the development of new oxide coatings that allow jet turbines to operate at ever-higher temperatures and therefore more efficiently, research in new materials and new architectures for “plastic” solar cells that convert sunlight to electricity in a manner that is competitive with the better known silicon variants, and new magnetic and semiconducting oxide materials for electronics beyond silicon. Chemistry is important to MS&E. However, for chemists to truly understand how they can play a role in new and critical materials-based technologies, they must in turn appreciate many aspects of the discipline of MS&E. For this, they may require courses that are not usually part of an undergraduate Chemistry degree.

Is this program for you?

This program is designed for students who wish to enhance their undergraduate education in chemistry by adding a strong knowledge base in the understanding of materials behavior, of their synthesis and processing, and of their applications in modern technology.

- The program allows outstanding students to concurrently pursue a Bachelor of Science degree in Chemistry, and a Master of Science degree in Materials, and to complete graduation requirements for both degrees within 5 years (see appendix for timelines and worksheets).
- The graduates of this program retain the breadth and flexibility inherent in chemistry, while their specialized knowledge of materials is expected to give them a competitive edge in the high technology industry.
- The program capitalizes on the emergence of UCSB as an internationally renowned institution in materials research and education. The students involved will interact with faculty working at the cutting edge of technology in a broad range of modern materials, benefiting from their advice and expertise in areas critical to future industrial development.

ADMISSIONS PROCESS

An informational meeting is typically held during the spring quarter for all sophomore students who may be interested in applying to the BS/MS program. After the meeting, students that are interested in the program must inform the DCB Undergraduate and the Materials Graduate Office of their intention to pursue the Materials BS/MS program. Students must consult with these offices about the admission procedures and the structure of the program.

Prior to the start of the junior year (or in the quarter when the student achieves junior status), candidates should arrange for a meeting with the Materials Department's BS/MS advisor for DCB (Professor Ram Seshadri) to discuss their interests, academic goals and program requirements.

The BS/MS advisor helps students plan their junior and senior year studies, in coordination with the student's own departmental B.S. program advisor, and also assist them during the application process for the program. In preparing their academic plan, all students interested in this program must plan on taking Matr1 100ABC during fall, winter, and spring of the junior year (no exceptions).

Applicants must meet the following requirements in order to qualify for admission:

- A minimum overall GPA of 3.2 at the end of the junior year, with a 3.5 minimum GPA in DCB courses, and a B minimum in each of the undergraduate Materials core courses (Matr1100A, Matr1 100B and Matr1 100C). Grades in physics, chemistry and math courses are particularly important, as are grades in core courses within the discipline.
- A GRE score with a minimum of 85% in the quantitative portion and performance in the verbal and writing sections comparable to the Materials Department entry class in the previous academic year. GRE scores must be submitted with the application, no later than the last working day of July to allow the admissions committee enough time to evaluate the application.

While some exceptions might be made for special circumstances, students must realize that they will be taking courses with Ph.D. oriented students from a very competitive pool in the graduate part of the program, so they must be able to perform academically well in that environment.

The student must submit a completed application for admission to the MS program in Materials under Plan II **following the guidelines of the Graduate Division** no later than the last working day of July prior to the start of Fall quarter of their Senior year. The application should be submitted on paper to the Materials Graduate Program Coordinator (academic@engineering.ucsb.edu), and must include:

- A Statement of Purpose, a Statement of Personal Achievements, and a Resume or CV.
- An official copy of the transcripts from UCSB and all post-secondary institutions.
- Three letters of recommendation from people able to judge the potential of the student for graduate studies. These people should ideally be faculty at UCSB or other higher education institutions who are familiar with the student's academic performance. Letters of recommendation should be mailed by post or electronic means directly by the recommender to the Materials Graduate Program Coordinator by the application deadline.

- Official GRE scores by the application deadline (last working day in July). Request that the official scores be sent to UCSB---Institution code 4835.
- Fill-out BS/MS schedule plan and have the BS portion approved by the DCB Undergraduate Office (Appendix B, pp. 14).

IMPLEMENTATION OF THE PROGRAM

Applicants will be notified of an admissions decision before the start of the fall quarter of the senior year. This is necessary for the student to be able to take graduate courses in the first quarter of the senior year and receive credit for them toward the MS degree. Upon admission to the program, the **student must select an emphasis** (Electronic, Inorganic, Macro-/Bio-molecular or Structural) and an MS advisor within the Materials Department (usually different from the BS/MS advisor listed above). The MS advisor will help the student prepare his/her MS study plan and the engineering report required for graduation (see below).

All students in the BS/MS program are required to prepare an MS study plan before the end of the fall quarter of their senior year.). A final MS study plan must be submitted before the start of the fall quarter of the graduate (5th) year. Approval of the final MS study plan is required before a BS/MS student is eligible for graduate status (i.e. before he/she completes 180 units).

In preparation for the materials graduate coursework, all BS/MS students must take Matrl 100A, B and C (Students interested in the BS/MS program should not take Matrl 101.) **In addition, students may take up to 6 units of approved undergraduate elective courses from the list in Table II** to be applied towards the MS. Chemistry undergraduate elective courses that are applied to the MS cannot count toward the BS in Chemistry. Non-chemistry courses in table II will not count towards the BS in Chemistry.

MS students within this program are also allowed to take courses outside their chosen areas of emphasis (Electronic, Inorganic, Macro-Biomolecular or Structural) with prior approval of their MS advisor and the departmental Materials Graduate Advisor. An MS student can petition to take more advanced elective courses outside this list, with prior approval of his/her MS advisor.) BS/MS students must also take during their senior year at least one graduate-level materials course per quarter towards the MS requirements from the list of graduate elective courses in Table III. All students must plan on taking Matrl 200A in the first quarter of the fifth year of the program. Matrl 200B and 200C are not required for BS/MS students, but may be taken as electives.

The final stage in the admission process is the advancement to graduate status. This change in status must happen prior to the beginning of the fall quarter of the fifth year in order to satisfy the [University minimum residency requirements \(3 quarters\)](#). BS/MS students are therefore advised to change from undergraduate to graduate status as soon as they complete 180 units of coursework. Students should not include graduate courses in the unit count toward the BS degree or they will not be credited toward the MS. The DCB Undergraduate Office will inform the BS/MS candidates when they are eligible for change of status. Once a BS/MS student reaches graduate status, he/she can begin to take the rest of the graduate unit requirements. Students should be aware that the change in status will prompt the Registrar to charge graduate fees for courses taken during this time.

Students in this program must satisfy the Plan 2 requirements for the MS degree in the

Materials section of the [UCSB General Catalog](#). They must complete 42 units of graduate coursework, including at least 27 units of approved 200 level courses (200-289), at most 6 units of approved advanced undergraduate elective courses (Table II) not already used for credit toward a previous degree¹, 3 units of seminars (Matrl 290) and at least 3 but no more than 6 units of independent studies (Matrl 596). Students in the BS/MS program are neither required nor eligible to be teaching assistants, and thus are not eligible to receive credit for teaching assistant practicum (Matrl 501).

The last requirement for all BS/MS students will be a final report based on work done as part of the independent studies unit requirement (3-6 units of Matrl 596). A committee of two faculty members must approve the report. One of them must be the person who supervised the student in Matrl 596 (typically the individual MS advisor). At least one of the faculty members evaluating the report must have a majority appointment in the Materials Department.

Note: In addition to fulfilling the requirements of the BS/MS program discussed above, students must ensure that they follow all the requirements of their individual undergraduate curricula for the Bachelor of Science in Chemistry. Tables are provided in the Appendix to help students in each curriculum understand how they can plan their BS/MS program to satisfy both the BS and the MS requirements within five years. At the end of a BS/MS student's senior year he/she has the option of filling out a BS graduation form and leaving the program with a BS degree, assuming all requirements for the BS have been met.

¹ Students are not required to take any undergraduate units toward their MS, but they are given the opportunity to count up to 6 units of courses that may be preparatory for some courses in the Materials MS, as long as those units are not already being used to fulfill BS degree requirements.

TABLE 1. TIMELINE FOR THE BS-CHEMISTRY/MS-MATERIALS PROGRAM

Year:	Summary of Events:
Second	<ul style="list-style-type: none">▪ Spring quarter: Notification to Undergraduate Office in DCB of student's interest in BS/MS program▪ Meetings with the Materials Department Graduate Program Coordinator and BS/MS program advisor for DCB, Professor Seshadri
Third	<ul style="list-style-type: none">▪ Fall: Matrl 100A; Winter: Matrl 100B; Spring: Matrl 100C▪ Winter: Take GRE▪ Spring: Submission of application to the Materials Graduate Program Coordinator for admission to the BS/MS Program
Fourth	<ul style="list-style-type: none">▪ Admission to program before beginning of Fall quarter.▪ Up to 6 units of additional undergraduate courses not applied already toward the BS degree may be taken in fourth or fifth year as preparation or complement to graduate courses in the MS program▪ One Graduate course each quarter▪ Change to graduate status before Fall quarter of the fifth year
Fifth	<ul style="list-style-type: none">▪ Remaining Undergraduate Courses, if any.▪ Matrl 200A (Fall) plus remaining Graduate Electives.▪ Graduate Seminar, Matrl 290 (3 units, one unit per quarter)▪ Independent Studies, Matrl 596 (3-6 units)▪ Deliver Engineering Report based on Independent Studies by Spring.

APPENDIX A
APPROVED COURSES

TABLE II. APPROVED UNDERGRADUATE COURSES

Fall	U	Winter	U	Spring	U
Undergraduate Core					
MATRL 100A* Structure & Properties I	3	MATRL 100B Structure & Properties II	3	Matrl 100C Structural Evolution	3
Undergraduate Electives					
CH E 102 Biomaterials and Biosurfaces	3	Phys/MATRL 135* Biophysics and Biomolecular Materials	3	Chemistry 145 Computational Biochemistry	3
CH E 121 Colloids and Biosurfaces	3	MATRL/CH E 160* Introduction to Polymer Science	3	Chemistry 175 Physical Inorganic Chemistry	
ECE/MATRL 162A Quantum Description of Electronic Materials	4	ECE/MATRL 162B Fundamentals of the Solid State	4	ECE 162C Optoelectronic Materials and Devices	4
Chemistry 115A Fundamentals of Quantum Chemistry				ME 141B: MEMS Semiconductor Processing and Device Characterization	4
ME 167 Structural Analysis	3	Chemistry 181 Protein crystallography		ME 166 Advanced Strength of Materials	3
ME/MATRL 185 Materials in Engineering	3	ME/MATRL 186 Matrls. and Manufacturing	3		

Important notes:

- Students are not required to take any undergraduate units toward their MS, but they are given the opportunity to count up to 6 units of courses that may be preparatory for some courses in the Materials MS.
- Chemistry undergraduate elective courses that are applied to the MS cannot count toward the BS in Chemistry.
- Non-chemistry courses in this table will not count towards the BS in Chemistry.
- Matrl 100B and 100C are required prerequisites for MS program, but they cannot be used to fulfill either BS or MS unit requirements.

Please check with individual departments as course scheduling may change from year to year and some courses may not be offered every year.

*100A, 135, and 160 may count toward the BS in Chemistry by petition; you must go to the DCB Undergraduate Office for this.

TABLE III. APPROVED GRADUATE COURSES FOR 4th/5th YEAR

Fall	U	Winter	U	Spring	U
Departmental Core and General Courses					
MATRL 200A Thermodynamic Foundation of Materials	4	MATRL 200B Electronic and Atomic Structure of Materials	4	Matrl 200C Structural Evolution in Materials	4
	3	MATRL 214: Advanced Topics in Equilibrium Statistical Mechanics	3	<i>MATRL 219: Phase Transformations</i>	3
MATRL 209A Crystallography and Diffraction Fundamentals	3		3		3
<i>MATRL 228: Computational Materials</i>	3		3	<i>MATRL 209C: Electron Microscopy II: Advanced Methods</i>	3
		MATRL 222A Colloids and Interfaces I	3	<i>MATRL 222B Colloids and Interfaces II</i>	3
Electronic Materials					
ECE/MATRL 162A Quantum Description of Electronic Materials	4	MATRL 206A Fundamentals of Electronic Solids I	4	MATRL 206B Fundamentals of Electronic Solids II	4
		MATRL 211A Engineering Quantum Mechanics I	4	MATRL 211B Engineering Quantum Mechanics II	4
MATRL 215A Semiconductor Device Processing I	4	MATRL 215B Semiconductor Device Processing II	4	MATRL 215C Semiconductor Device Processing III	4
MATRL 205: Wide Band Gap Materials and Devices	3		3	MATRL 217: Molecular Beam Epitaxy and Band Bap Engineering	3
<i>MATRL 216 Defects in Semiconductors</i>	3		3	MATRL 227: Metal-Organic Chemical Vapor Deposition	
Inorganic Materials					
		MATRL 218: Introduction to Inorganic Materials	3	MATRL 204 Introduction to Magnetism and Magnetic Materials	3

	3		3	<i>MATRL 226: Electrical and Functional Crystals and Ceramics</i>	3
Macromolecular and Biomolecular Materials					
MATRL 271A Synthesis and Properties of Macromolecules	3	MATRL 271B: Structure and Characterization of Complex Fluids	3	MATRL 271C Properties of Macromolecules	3
MATRL 273 Experiments in Macromolecular Materials	3	MATRL 284: Synthetic Chemistry of Macromolecules	3	<i>MATRL 277: Synthesis of Biomolecular Materials</i>	3
<i>MATRL 276A: Biomolecular Materials I: Structure and Function</i>	3	<i>MATRL 276B: Biomolecular Materials II: Applications</i>	3	<i>MATRL 278: Interactions in Biomolecular Complexes</i>	3
<i>MATRL 253: Liquid Crystal Materials</i>	4				3
Structural Materials					
MATRL 207 Mechanics of Materials	3	MATRL 220 Mechanical Behavior of Materials	3	MATRL 234: Fracture Mechanics	3
<i>MATRL 230: Elasticity and Plasticity</i>	3	<i>MATRL 263: Thin Films and Multilayers</i>	3	MATRL 240: Finite Element Structural Analysis	3
		<i>MATRL 261 Composite Materials</i>	3		3
	3	<i>MATRL 284: Solid State Inorganic Materials</i>	3	<i>MATRL 251A: Processing of Inorganic Materials</i>	3

Notes:

- Students are expected to design a program of study based on the above courses (Tables II and III) with assistance from their faculty advisor.
- **Courses in bold are departmental or area core for the Ph.D.** Courses in normal font are electives offered every year. *Courses in italic are electives offered every other year.* (Course schedules and frequency are subject to change.).
- Some introductory graduate courses will not be available for credit to students who have taken undergraduate courses covering similar topics, e.g. students cannot get credit toward the MS for ME 166 or ME 162 if they are taking Matrl 207

APPENDIX B
BS/MS SCHEDULE
PLAN

BS-CHEMISTRY/MS-MATERIALS

FALL		Winter		Spring	
Course	(Units)	Course	(Units)	Course	(Units)
Year 1					
Chem 1A/2A	(3)	Chem 1B/2B	(3)	Chem 1C/2C	(3)
Chem 1AL/2AC	(2)	Chem 1BL/2BC	(2)	Chem 1CL/2CC	(2)
Math 3A	(4)	Math 3B	(4)	Math 4A	(4)
GEs	(4+)	Phys 1	(4)	Phys 2	(4)
GEs	(4+)	GEs	(4+)	GEs	(4+)
Year 2					
Chem 109A/109AH	(4)	Chem 109B/109BH	(4)	Chem 109C/109CH	(4)
Phys 3	(3)	Chem 6AL	(3)	Chem 6BL	(3)
Phys 3L	(1)	Phys 4	(3)	GEs/UG Electives	(3+)
Math 4B	(4)	Phys 4L	(1)	GEs/UG Electives	(3+)
		Math 6A	(4)		
Year 3					
Chem 113A	(4)	Chem 113B	(4)	Chem 113C	(4)
Chem 142A	(3)	Chem 116AL	(3)	Chem 116BL	(3)
Chem 150	(3)	GEs/UD Electives	(3+)	GEs/UD Electives	(3+)
Chem 6CL	(3)	Matrl 100B	(3)	Matrl 100C	(3)
GEs/UD Electives	(3+)				
Matrl 100A*	(3)				
Year 4					
Chem 173A	(3)	Chem 173B	(3)	GEs/UD Electives	(3+)
Chem 116CL	(3)	GEs/UD Electives	(3+)	GEs/UD Electives	(3+)
GEs/UD Electives	(3+)	GEs/UD Electives	(3+)	GEs/UD Electives	(3+)
Matrl 209A	(3)	Matrl 218	(3)	Matrl 209BL	(3)
Year 5					
Matrl 200A	(4)				
Matrl 290	(1)	Matrl 290	(1)	Matrl 290	(1)
Matrl 596		Matrl 596		Matrl 596	
ΞMatrl Electives (2-3 Matrl courses)		ΞMatrl Electives (2-3 Matrl courses)		ΞMatrl Electives (2-3 Matrl courses)	

Ξ Denotes Materials elective course, to be chosen from Table III of approved courses
 Some optional UG electives (Table II): ChemE160 [Polymers, Winter], Matrl 135 [Bio/Macro, Winter] ChemE 121 [Colloids, Fall]

NOTE THAT 209A, 218 and 209BL are nominally electives, so it should be noted that these are only recommendations for the senior year if the student decides to follow the Inorganic emphasis within the MS in Materials.

*Student may petition to have Matrl 100A count toward BS in Chemistry. Please see DCB Undergraduate Office. Matrl 100B and 100C are required prerequisites for MS program, but they cannot be used to fulfill either BS or MS unit requirement

BS-CHEMISTRY/MS-MATERIALS PLAN

THIRD YEAR						Requirements & Reminders:
FALL		WINTER		SPRING		
Course:	Units:	Course:	Units:	Course:	Units:	
Matrl 100A	3	Matrl 100B	3	Matrl 100C	3	
TOTAL:		TOTAL:		TOTAL:		
FOURTH YEAR						Requirements & Reminders:
FALL		WINTER		SPRING		
Course:	Units:	Course:	Units:	Course:	Units:	
Grad course		Grad course		Grad course		
TOTAL:		TOTAL:		TOTAL:		
FIFTH/MASTER'S YEAR						Requirements & Reminders:
FALL		WINTER		SPRING		
Course:	Units:	Course:	Units:	Course:	Units:	
Matrl 200A	4					
Matrl 290	1	Matrl 290	1	Matrl 290	1	
TOTAL:		TOTAL:		TOTAL:		
<p><i>*Up to 6 units of additional UG courses not applied already to the BS degree could be taken as preparation or complement to grad courses in the MS program</i></p> <p>Approval of BS study plan: UG department advisor: _____</p>						<p>Take GRE</p> <p>Get to know faculty</p> <p>Apply by the last working day of July</p> <p>Receive a B minimum in 100ABC</p> <p>Take one graduate course each quarter</p> <p>Confer BS degree, change to grad status</p> <p>Take remaining UG courses, if any</p> <p>Take Matrl 200A in Fall</p> <p>Take remaining Graduate electives*</p> <p>Take 1 unit of 290 seminar per quarter (3 units)</p> <p>Take 3-6 units of 596 research and complete engineering report</p>

MATERIALS DEPARTMENT

MS Study Plan 2 for BS/MS Students*

Name: _____

Last

First

MI

Email address: _____ Perm number: _____

Undergraduate Department: _____

Graduate Major Field in Materials: _____

Faculty MS Advisor: _____

Program Plan Approval:

Faculty MS Advisor Signature _____

Department Graduate Advisor Signature _____



Graduate Core Course:

Matrl 200A: 4 units

Matrl 290: 3 units

Graduate Electives (23-32 units):

Matrl 596 (3-6 units): _____

Optional UG (3-6 units): _____

Total Graduate Units: 42

Report Committee (2 faculty members):

(Chair, MS Advisor)

Member

* NOTE: This is a proposed study plan that must be submitted by the end of fall quarter of your fourth year. A final MS study plan must be submitted later for advancement.

<p><i>For departmental use only.</i></p> <p>Date Residency Requirement Satisfied _____</p> <p>Date UG Requirements Completed: _____</p> <p>Entrance Date: _____</p> <p>Change to MS Status Date: _____</p> <p>Date Graduate Requirements Fulfilled: _____</p>

Acknowledgment of Having Read BS/MS Student Manual

(Print this page, sign it after reading the manual and turn it in to the Graduate Program Coordinator)

I, _____ acknowledge that I have carefully read and understood the contents of the BS/MS Student Manual for the Materials Department (Edition Fall 2015). I understand my first point of contact for any questions regarding the BS/MS Manual or the BS/MS Materials Program is the Graduate Program Coordinator* in the Materials Department, who may refer me to the Graduate Advisor** in the Materials Department or the BS/MS advisor for DCB***

Signature

Date

After having read and signed this page, it must be turned into the Graduate Program Coordinator in the Materials Department by the end of the fall quarter of your senior year.

* The current Graduate Program Coordinator is Ms. Jocelyn Guzman

** The current Graduate Advisor is Prof. Carlos G. Levi

*** The current BS/MS advisor for DCB is Prof. Ram Seshadri