REVISIONS TO DISCIPLINES LIST FORM

DATE SUBMITTED: September 28, 2021
(Deadline for submission is September 30th each year)

DISCIPLINES LIST TITLE: Nanotechnology (Abbreviation: “NANO”)

This proposal is for a: New discipline

Reason for the proposal: Create a new discipline

PROPOSAL LANGUAGE: (If this is an existing minimum qualification, please include the original language and change using strikeouts and italics).

M.S. in a STEM-related field, such as Chemistry, Physics, Biochemistry, or Engineering and a minimum of two years teaching nanotechnology courses in a college/university or two years of industry work experience as a leading scientist/engineer on a nanotechnology project.

PROPOSAL EVIDENCE:

Required: (1) Investigation of the following and (2) Statement of Findings:

- Contacted an associated professional organization to determine support of proposal.
  - Letters of support have been attached from:
    - nanoBCA - Nanotechnology Business Commercialization Association
    - Omni Nano
    - The Kavli Nanoscience Institute
    - UCSB Nanofab
    - Center for Nanotechnology Education and Utilization
    - The Micro Nano Technology Education Center
    - The Micro and Nanotechnology Commercialization Education Foundation
    - National Institute of Innovation and Technology

- Included evidence of degrees within the proposed revision of the discipline or new discipline.

- Provided a list of the titles of the degrees and programs to document the need for a new or revised discipline using the below criteria:
  
  Advanced Materials – Nanotechnology is a new certification and associate degree approved by the Los Angeles and Orange County Regional Consortium (LAOCRC). Three courses in Nanotechnology have been approved by the State of California, and the application for creating a new statewide degree is already in progress.
Pasadena City College will start offering such a degree/certification from the Fall of 2022.

At least two other community colleges are following in PCC’s footsteps. Both Santa Barbara Community College and Southwestern Community College (in San Diego) are currently reviewing similar proposals for certification and degree programs at their respective institutions.

Currently, there are several universities that offer Master of Science (27 programs) or Doctorate programs (22 programs) complete list at https://www.nano.gov/education-training/university-college These programs include:

1. Master of Science in Nanotechnology Engineering, University of California, Riverside
2. Master of Science in Nanoengineering, University of California, San Diego
3. Doctorate of Nanoscale Science and Engineering, University of California, Berkeley
4. Doctorate of Chemistry with Materials and Nanoscience Specialization, University of California, Los Angeles
5. Doctorate of Nanoengineering, University of California, San Diego

In addition, there are 36 Bachelor of Science/Engineering program in Nanotechnology in the United States including:

1. BS in Nanoengineering, University of California at San Diego
2. BS in Materials Science with a concentration in nanomaterials and sensors, University of California, Riverside
3. BS in Materials Science with a nanoscience concentration, Stanford University
4. Minor in Nanotechnology, University of Southern California

☐ Provided evidence of statewide need to show that a change is necessary and is not merely a response to a unique need of one college, district or region.

Under the current ASCCC Disciplines List, courses for this new certificate and degree in Advanced Materials – Nanotechnology would have to be listed under other disciplines, such as Chemistry, Engineering, or Physics.

However, Advanced Materials – Nanotechnology is much more than just Chemistry, Engineering, or Physics. Rather, it has grown to become its own independent field of study as well as employment. In fact, there are many scholarly journals dedicated to Nanotechnology and the U.S. Department of Labor also recognizes Nanotechnology Technologists as a career: https://www.onetonline.org/link/summary/17-3026.01

If Advanced Materials – Nanotechnology courses and degrees are inappropriately labeled, it limits the career opportunities for graduates. For example, students currently pursuing Advanced Materials – Nanotechnology may have transcripts indicating they are studying to become “Chemical Technicians.” This is an outdated term for a position with few openings, whereas “Nanotechnologist” positions are widely available and always hiring. In support of these statements, we have attached here:
1. A recent Labor Market Analysis
2. The report of the Industry Advisory Board at PCC

In the California Community College system, this is a partial list of campuses that are looking to offer certifications and/or degrees in Advanced Materials - Nanotechnology:

• Pasadena City College
• Santa Barbara Community College
• Southwestern College
• Allan Hancock College

- Included a discipline seconder from another district

  • Juan Gonzalez-Gonzalez, Southwestern College; igonzalez3@swccd.edu; 619-813-8520
  • Jens Kuhn, Santa Barbara Community College; jkuhn@sbcc.edu; 805-961-9828

- Explained the impact of proposal across the state using a list of pro and con arguments and included refutation of the con arguments

**PRO ARGUMENTS**

1. The State of California has one of the largest clusters of high-tech companies researching and developing advanced materials, nanoscience, and semiconductors. However, it is not meeting current demands for labor. One way to bridge this gap is to offer an appropriately dedicated discipline listing at the community college level.

2. Due to this labor demand, the State of California has pushed for STEM education generally and specifically for Advanced Materials – Nanotechnology. For example, the California NanoSystems Institute (CNSI), housed at UCLA, was established in 2000. This proposal advances these efforts.

3. In California, Bachelor’s and Master’s programs in Advanced Materials – Nanotechnology have existed for over 10 years. Outside of California, Associates and certification programs have been available at community colleges for over 15 years. From this perspective, adding Advanced Materials – Nanotechnology to the list of California community college disciplines is long overdue.

4. With this addition, any community college in California will be able to easily offer the Nanotechnology courses already approved by the State. PCC will be the first California community college to offer certificates and degrees in Advanced Materials – Nanotechnology and other community colleges can follow suit.

5. As supported by the attached Labor Market Analysis, there are many available jobs in Advanced Materials – Nanotechnology. Conversely, there are fewer and fewer job openings for other types of engineers and technicians.

6. We can create more competitive career opportunities for our graduates by officially designating Advanced Materials – Nanotechnology. Currently, students are graduating with Chemistry on their transcripts, while Chemical Technician jobs are waning.

7. This will also create more competitive recruitment campaigns for potential students.

8. For hiring administrators, the designation “NANO” (as opposed to “CHEM,” etc.) makes it easier to understand the modern education of our graduates. For students, Advanced Materials – Nanotechnology is an ideal “umbrella” subject that demonstrates the many opportunities STEM careers offer.
CON ARGUMENTS

1. Widespread community college and statewide adoption has not yet occurred.
   a. Refutation: One of the things that makes California great is that we are a State of “Firsts.” By making this first step, we will empower our small community to continue growing.

☐ Provided other evidence, such as significant changes to the field, that requires a change to the Disciplines List.

SUBMISSION

Contact person (author of proposal): Jared M. Ashcroft

Phone number (please provide at least two numbers and indicate if cell/home/work, etc.): (626) 585-7007 (office); 951-448-2981 (cell)
Email address: <JMASHCROFT@pasadena.edu>

Seconder (must be from another District):
• Juan Gonzalez-Gonzalez, Southwestern College; jgonzalez3@swccd.edu; 619-813-8520
• Jens Kuhn, Santa Barbara Community College; jkuhn@sbcc.edu; 805-961-9828

Phone number (please provide at least two numbers and indicate if cell/home/work, etc.): (see above)
Email address: (see above)

Signature of College Academic Senate President: 

College: Pasadena City College

Email address: glopez@pasadena.edu

Date approved by College Academic Senate: Sep 28, 2021

OR
Organization ________________________ President ________________________

Phone for President: ________________________________

Date Approved by Organization: ______________________

RETURN FORM TO:

The Academic Senate for California Community Colleges
One Capitol Mall, Suite 340, Sacramento, CA 95814
Email: disciplineslist@asccc.org

4By signing this document, the Senate President is certifying that the required investigation and statement of findings have been sufficiently addressed.
Date: September 24, 2021
From: Vincent Caprio
To: California Community Colleges Academic Senate Board
Re: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

To Whom It May Concern,

The Nanobusiness Commercialization Association (NanoBCA) is a 501(c)(3) non-profit organization dedicated to educating America in regard to benefits of the science of nanotechnology. NanoBCA’s mission statement is to create a friendly environment that nurtures research and innovation in nanotechnology, promotes tech-transfer of nanotechnologies from academia to industry, encourages private capital investments in nanotechnology companies, and helps its company members bringing nanotechnology products to the market.

Founded in 2001, NanoBCA is the world’s first nonprofit association focused on the commercialization of nanotechnologies. Since its establishment, NanoBCA has been advocating for the continued allocation of significant funds per the National Nanotechnology Initiative (NNI). NanoBCA’s dedicated work in shaping national nanotechnology policy has created a favorable policy climate for nanotechnology at every level, benefiting academic research, small businesses, and the manufacturing industry. NanoBCA has been advocating Congress to ensure the continuous allocation of government funds to nanotechnology, such as basic research and SBIR grants, throughout all the major government agencies (DOD, DOE, NSF, NIH, etc.).


There are multimillion dollar initiatives requiring nanotechnology and knowledge of nanoscale systems, including:

1. DOE’s $100 Million Energy-Water Desalination Hub to Provide Secure and Affordable Water
2. DOE’s $100 Million Project to Advance Hydrogen and Fuel Cell Capabilities
3. The American Foundries Act Of 2020

All these initiatives need scientists, engineers and technicians knowledgeable in the science of nanotechnology. The inclusion of nanotechnology as an academic discipline is critical, especially given the importance of nanotech in strategic sectors, such as biotechnology, energy, water purification, and defense.

We support your initiative to include the science of nanotechnology as a part of the CCC Minimum Qualifications (MQ) Handbook.

Regards,

Vincent Caprio

Vincent Caprio, MBA, MPA
"Serving the Nanotechnology Community for Two Decades"
Executive Director
NanoBusiness Commercialization Association
203-733-1949
vincentcaprio@nynanobusiness.org
www.vincentcaprio.org
From: Dr. Marco Curreli, Executive Director, Omni Nano
To: California Community Colleges Academic Senate Board
Re: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

September 14, 2021

To whom it may concern,

Omni Nano is a Los Angeles-based non-profit organization devoted to Nanotechnology education. Since 2012, Omni Nano has been exploring effective methods to bring Nanotechnology courses into American educational institutions, particularly high schools and community colleges in the County of Los Angeles and State of California. In 2019, our digital Nanotechnology curriculum was the first to be officially adopted by the nation’s second-largest school district, the Los Angeles Unified School District (LAUSD).

I (Dr. Marco Curreli) have witnessed firsthand students’ enthusiasm for Nanotechnology. I personally instructed pilot Nanotechnology courses based on Omni Nano’s curriculum within the California Community Colleges (CCC). In collaboration with West Los Angeles College (WLAC), I had three (3) new Nanotechnology courses approved by the CCC’s Chancellor’s Office. As a result, these courses can be offered in every community college in California.

Creating a standalone Nanotechnology discipline will help attract more students as well as well-qualified instructors. Since 2017, I have offered a course at WLAC. However, because Nanotechnology is not (yet) recognized as its own discipline, these courses were offered under Chemistry. Thus, they are labeled on students’ transcripts as “CHEM.” Appropriately labeling them as “NANO” courses will improve their appeal and facilitate their transferability into the University of California (UC) system.

Nanotechnology must be recognized by the CCC as a separate field in academia, as it is already recognized in industry. Nanotechnology cannot be appropriately classified as simply Chemistry, Physics, or Engineering. It is its own independent field of study and employment. Nanotechnology Technologists, a career formally recognized by the US Department of Labor, are in higher demand with respect to traditional lab technicians.

Omni Nano supports this proposal to add Nanotechnology to the CCC Minimum Qualifications (MQ) Handbook.

The field of Nanotechnology has flourished over the past 20 years with a rich volume of specialized publications and excellent programs at major universities across the country. Numerous institutions in California are dedicated to nanoscience and nanotechnology research. The California NanoSystems Institute (CNSI), founded in 2000, is an integrated nanotechnology research center operating jointly at UC Los Angeles and UC Santa Barbara. The Kavli Nanoscience Institute (KNI) was established in 2003 at CalTech. In 2007, UC San Diego became the first UC to establish a Department of NanoEngineering, which confers both undergraduate and graduate degrees.

We hope that the consideration and support of the CCC Board will be afforded to Nanotechnology degrees, certifications, and other indicators of training and education in this growing field. We support our associates in the Community Colleges as they seek this formal recognition for the critical work they are already doing.

Sincerely,

Marco Curreli, Ph.D.
Date: September 21, 2021  
From: Tiffany Kimoto, Executive Director, Kavli Nanoscience Institute  
To: California Community Colleges Academic Senate Board  
Re: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

To whom it may concern,

The Kavli Nanoscience Institute (KNI) at the California Institute of Technology is a research center dedicated to supporting the frontiers of nanoscience and nanotechnology. Established in 2003, the KNI has facilitated scientific advancements across a wide range of fields, including optics, electronics, novel materials, alternative energy, biomedical devices, neurophotonics, sustainability and more. The KNI supports more than 35 faculty members and their research groups at Caltech, along with scientists and researchers from other academic and government institutes as well as across industry, through its multi-user nanofabrication and characterization cleanroom facility, the KNI Laboratory. The KNI Laboratory opened its doors in 2008 and since then, it has provided training, support for, and access to advanced instrumentation for well over 500 scientists, most of whom were and are graduate students.

As an organization founded within one of the leading engineering and research educational institutes in the world, we can attest to the importance of educating and training young minds in STEM, particularly nano-related fields.

We understand there is a proposal to add Nanotechnology to the CCC Minimum Qualifications (MQ) Handbook. Including Nanotechnology as an academic discipline is much needed, particularly given its inherent relevance and impact across major disciplines and industries at the local, state and national levels.

On behalf of the Kavli Nanoscience Institute, I am writing in full support of this proposal. Offering Nanotechnology as its own independent field of study in academia validates the importance of this topical area and properly aligns it with industry values and other vocational pathways. As its own broad field of study, Nanotechnology would benefit from having the distinction from the general field of Engineering.

Nanotechnology is a broad academic field that has flourished over the past thirty years in terms of research and development, highly accomplished scholars and alumni, and robust programs at major universities across the country. Numerous institutions in the
state and across the country are dedicated to nanoscience and nanotechnology research. One such example is the California NanoSystems Institute (CNSI), an integrated nanotechnology research center founded in 2000 which operates jointly between UC Los Angeles and UC Santa Barbara. Moreover, independent science-focused organizations have identified nanoscience as a critical area to support, marking the importance of this field and its vital influence on society. One example is the Kavli Foundation, which has created and supported five high-impact nanoscience research centers across the globe, including our institute, the KNI.

The precedent for Nanotechnology as its own independent academic field has been established. In 2007, UC San Diego became the first UC to create a Department of NanoEngineering, which confers both undergraduate and graduate degrees. Further, West Los Angeles College (WLAC) has offered courses in Nanotechnology since 2017, which are now being offered at Pasadena City College (PCC) as well.

We hope that the consideration and support of the CCC Board will be afforded to Nanotechnology degrees, certifications, and other indicators of training and education in this growing field. We strongly support our colleagues in the Community Colleges as they seek this formal recognition for the important work they have done and continue to do for the future scientific, academic, and technical workforce in this country.

Sincerely,

Tiffany Kimoto

Executive Director
Kavli Nanoscience Institute
California Institute of Technology
To: California Community Colleges Academic Senate Board  
Re: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

The U.C. Santa Barbara Nanofabrication facility is a shared-use multi-user micro/nano-fabrication facility that hosts approx. 200 industrial users and 50 academic users per year. Facility staff routinely interact with owners & officers of large and small manufacturing companies, along with their fabrication technicians that physically utilize the facility. The cities of Santa Barbara and Goleta, with a combined population of less than 150,000, host more than 40 small companies and 7 large companies that utilize semiconductor cleanroom facilities in their manufacturing, earning the region the nickname “infrared valley” – although local companies span the micro-nano-technology application space including microelectronics, microfluidics, integrated photonics (LED’s/Lasers), quantum computing, biotechnology, medical imaging and space-based applications.

During the 2020-2021 pandemic the facility remained open, with industrial users maintaining a strong presence, even adding new employees, despite occupancy restrictions. The UCSB Nanofab, being a local hub for employers to advertise job openings, experienced a marked increase in the number of job postings from May to August 2020, posting 13 jobs at local (Santa Barbara and Goleta) companies in May and June 2020 alone. 23% of these openings were technician-level (see full listing at santabarbara.tech). The Southern California regions closer to Los Angeles and San Diego host an even greater number of nanotech companies. This uptick in job openings been typical during recessions, including the 2008 recession, due to increased government and industrial investment directly into high-tech manufacturing and innovation at such times.

Over the last four years, Dr. Demis D. John, UCSB Nanofab staff, has performed local industry investigations into the significant workforce issues in the region, resulting in a 2021 award by the National Science Foundation to build training programs for the Micro/Nano-tech fields in the Santa Barbara region (NSF award # 2100405). These investigations revealed that the Los Angeles area hosts an even larger number of companies, and that about 50% of local employers identify hiring to be a significant impediment to growth.

The presence of a Nano-technology targeted City College program would improve industrial growth by demonstrating to employers that California-local graduates are (a)
capable of the required imaginative and meticulous hands-on fabrication tasks, and (b) have demonstrated interest and aptitude enough to complete the program. These are two of the primary difficulties local employers have faced in identifying candidates and meeting their hiring goals. Alleviating this workforce situation may reduce out-of-state hiring, which is potentially associated with local housing shortages.

The specific term “nanotechnology” does indicate to employers a specific hands-on specialty beyond existing physics, chemistry or STEM courses. In addition, the program would benefit employers across a broad range of disciplines, as exhibited by the UCSB Nanofab’s extremely varied technologies, all being fabricated with the same skill set in a single facility.

We encourage the CCC Board to modernize City College educational programs by building a nanotechnology discipline, and thus increase the percentage of California-local hires into these lucrative and thriving manufacturing fields.

Sincerely,

Demis D. John

demis@ucsb.edu
Process Scientist Manager
UCSB Nanofabrication Facility
September 21, 2021

To whom it may concern,

On behalf of the Penn State Center for Nanotechnology Education and Utilization, I am pleased to support the proposal to add Nanotechnology to the CCC Minimum Qualifications (MQ) Handbook, which we understand guides faculty hiring. We agree with your assessment that the inclusion of Nanotechnology as an academic discipline is both necessary and long overdue, especially given the growth and importance of the field both nationally and particularly in California.

CNEU is the home of the NACK National Resource Center is funded by the National Science Foundation Advanced Technological Education (ATE) to provide national coordination of workforce development programs and activities to meet industry needs for nanotechnology workers. The NACK Resource Center has a mission to provide assistance to existing or developing micro- nanotechnology workforce education programs at 2-year community and technical colleges and 4-year universities and colleges in partnership with community and technical colleges across the United States. Nano workforce infrastructure that the Resource Center is creating includes establishing nanotechnology workforce stackable certificates and the RAIN (Remotely Accessible Instruments for Nanotechnology) Network. CNEU is also the home of the PA Nanofabrication Manufacturing Technology (NMT) partnership which provides an 18 credit (full semester) hands-on nanotechnology capstone semester.

It is essential for Nanotechnology to be recognized by the CCC as a separate field in academia, as it is already widely recognized in industry. Nanotechnology cannot be appropriately classified as simply Engineering. It is its own independent field of study and employment. Nanotechnology Technologists, a career formally recognized by the US Department of Labor, are skyrocketing in growth.

The field of Nanotechnology has flourished over the past three decades with a rich volume of scholarship, highly accomplished scholars and alumni, and excellent programs at major universities across the country. As a national center since 20028, we are very aware that numerous institutions in California and all across the US are dedicated to nanoscience and nanotechnology research. For example, the California NanoSystems Institute (CNSI), founded in 2000, is an integrated nanotechnology research center operating jointly at UC Los Angeles and UC Santa Barbara. The Kavli Nanoscience Institute (KNI) was established in 2003 at CalTech. In 2007, UC San Diego became the first UC to establish a Department of NanoEngineering, which confers both undergraduate and graduate degrees. West Los Angeles College (WLAC) has had courses in Nanotechnology since 2017, which are now being offered at Pasadena City College (PCC) as well.

We hope that the consideration and support of the CCC Board will be afforded to Nanotechnology degrees, certifications, and other indicators of training and education in this growing field. We support our colleagues in the Community Colleges as they seek this formal recognition for the important work they are already doing.

Sincerely,

Robert K. Ehrmann
September 27, 2021

From: The Micro Nano Technology Education Center (MNT-EC)

To: California Community Colleges Academic Senate Board

RE: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

Dear Senate Board,

The Micro Nano Technology Education Center (MNT-EC) strives to grow the MNT technician workforce by fostering academic and industry mentorship between existing MNT partners and educators developing prospective community college MNT programs. MNT-EC provides resources such as cleanrooms, educational materials, and remote operation of lab instruments, to support and inform the development of a common curriculum for associate degrees and certificates in micro nano technologies.

Over the last year, the push to increase micro nanotechnology industry in the United States shows the need to grow community college micro- and nano- certificate and associate’s degree programs. President Biden signed Executive Order 14017 “America’s Supply Chain” that aims to increase production of semiconductor chips in the United States, a micro nanotechnology industry. More than ever the creation of micro nanotechnology community college education pathways is vital to sustain growth within MNT industries.

Nanotechnology is a multidisciplinary discipline with a reach into Chemistry, Physics, Materials Science, Advanced Manufacturing, among others. This multidisciplinary nature creates a need for a discipline specific to nanotechnology to provide programs to recruit from a wider net of perspective faculty members.

On behalf of the directorate and members of the Micro Nano Technology Education Center it is my pleasure to support inclusion of nanotechnology as part of the CCC Minimum Qualifications.

Warm regards,

Billie Copley
Program Manager, Micro Nano Technology Education Center
billie@micronanoeducation.org
26 September 2021

From: The Micro and Nanotechnology Commercialization and Education Foundation (MANCEF)
To: California Community Colleges Academic Senate Board
RE: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

Dear Senate Board,

The Micro and Nanotechnology Commercialization and Education Foundation (MANCEF) has provided a focus on micro and nanotechnology awareness for 25 years as a 501(c)(3) non-profit organization. Our group is comprised of micro and nanotech stakeholders from the ‘triple-helix’ of industry, academia and government whose passion it is to provide support to those engaged in leveraging these technologies to improve our world.

What is most evident from this work is that the fuel for continued accelerating growth and impact of nanotechnology is found from people prepared with an education to appreciate its vast areas of application. Now more than ever the education of technologists and associates with nanotechnology skillsets has become a principal need to sustain this growth.

A requirement for emphasis on nanotechnology and science in community college finds support from the following example impact areas which MANCEF contributes to by its conferences on commercialization, seminars on lessons learned and funding access, entrepreneurial workshops and efforts in workforce development. The following disciplines with which MANCEF engages are witness to the explosive impact nanotechnology will continue to have on our world economically, socially, and environmentally:

- Nanotechnology enabled startup and growth of industry in the areas of molecular diagnostics; pathology; advanced materials for energy, transportation, communications, computation and human machine interfaces; new medicine practices – glaucoma, cancer and leukemia, genetic tailoring, wound treatment, implants, tissue engineering; pharmaceuticals – direct drug manufacture; synthetic biology; direct nano-scale manufacturing and testing; wellness and healthcare monitoring; automation; antimicrobials...

From such manifold examples, MANCEF receives direct feedback on requirements and talent need trends all pointing to technologist workforce awareness of nanotechnology.

On behalf of the directorate and members of MANCEF (the Micro and Nano Commercialization and Education Foundation) it is my pleasure to support inclusion of nanotechnology as part of the CCC Minimum Qualifications and believe the timing for instituting such an initiative could not be better.

Sincerely,

Todd Christenson, Ph.D.
President, MANCEF
Co-Founder, CTO & Chairman Emeritus, HT MicroAnalytical, Inc.
toddchristenson@mancef.org
September 27, 2021

To: California Community Colleges Academic Senate Board  
Re: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

To Whom It May Concern:

The National Institute for Innovation and Technology is a not-for-profit organization with a mission to identify roadblocks to innovation in strategic industry sectors – those important to U.S. national security and global competitiveness – and ensure they are eliminated. The Institute has a primary focus on developing and maintaining the talent pipeline in technical/STEM fields as access to, retaining and training the workforce required by these industries is seen as a top priority.

In a recent internal survey, over 80% of semiconductor industry respondents stated lack of workforce was standing in the way of business growth and sustainment. Through comprehensive industry engagement and the support of the federal agencies, the Institute is developing a nationally integrated, state-of-the-art, competency-based infrastructure that connects industry, academia and individuals. Our initial focus has been the semiconductor industry and we are now expanding it to include nanotechnology more broadly.

Employers throughout the semiconductor supply chain require technicians, engineers and scientists in order to design, produce and enable the technologies that are driving all aspects of our lives today. A modern semiconductor fab workforce consists of approximately 15% PHDs, 20% engineers and approximately 60% technicians from various disciplines and levels. The explosion of the application of nanotechnology will only mean that the need for this talent will only increase in the future.

The inclusion of nanotechnology as an academic discipline is critical in developing the talent pipeline for strategic industry sectors. The Institute supports your efforts to include nanotechnology as part of the CCC Minimum Qualifications (MQ) Handbook.

Sincerely,

_______________________________________
Michael A. Russo,
President & CEO
National Institute for Innovation and Technology
September 22, 2021

To: California Community Colleges Academic Senate Board

Re: Revisions to the CCC Minimum Qualifications Handbook: Nanotechnology

To Whom It May Concern:

Santa Barbara City College (SBCC) continues to support projects that integrate nanotechnology into existing curriculum and hands-on student learning experiences. In 2017, faculty developed a Nanoscience in Society course, taught as an interdisciplinary physical science course. Faculty and administrators at SBCC maintain on-going collaborations with the Center for Science and Engineering Partnerships at the California NanoSystems Institute (CNSI) at UC Santa Barbara. One of these on-going efforts resulted in a recently funded National Science Foundation (NSF) Advanced Technological Education (ATE) project in Micro/Nanotechnology Education.

We have reviewed the 2021 proposal to add Nanotechnology to the CCC Minimum Qualifications (MQ) Handbook, which we understand guides faculty hiring. We agree with your assessment that the inclusion of Nanotechnology as an academic discipline is both necessary and long overdue, especially given the growth and importance of the field both nationally and particularly in California.

We are writing to support this proposal. It is essential for Nanotechnology to be recognized by the CCC as a separate field in academia, as it is already recognized in industry. Nanotechnology cannot be appropriately classified as simply Engineering. It is its own independent field of study and employment. Nanotechnology Technologists, a career formally recognized by the US Department of Labor, are skyrocketing in growth while other Technologist careers have suffered from the pandemic.

The field of Nanotechnology has flourished over the past three decades with a rich volume of scholarship, highly accomplished scholars and alumni, and excellent programs at major universities across the country. Numerous institutions in California and all across the US are dedicated to nanoscience and nanotechnology research. For example, the California NanoSystems Institute (CNSI), founded in 2000, is an integrated nanotechnology research center operating jointly at UC Los Angeles and UC Santa Barbara. The Kavli Nanoscience Institute (KNI) was established in 2003 at CalTech.

In 2007, UC San Diego became the first UC to establish a Department of NanoEngineering, which confers both undergraduate and graduate degrees. West Los Angeles College (WLAC) has had courses in Nanotechnology since 2017, which are now being offered at Pasadena City College (PCC) as well.

We hope that the consideration and support of the CCC Board will be afforded to Nanotechnology degrees, certifications, and other indicators of training and education in this growing field. We support our colleagues in the Community Colleges as they seek this formal recognition for the important work they are already doing.

Sincerely,

Jens-Uwe Kuhn, Ph.D.
ATE Project PI (Micro/Nanotechnology)
To whom it may concern,

Southwestern College (SWC) serves the southern part of San Diego County. The SWC service district spans from the San Ysidro US-Mexico border to the city of National City, which neighbors Downtown San Diego. The Southwestern Community College District (SWCCD) serves one of the most racially, ethnically, and culturally diverse communities among the 115 colleges and 72 districts comprising the CCC system. The SWCCD serves approximately 28,000 students each year and is designated as a Hispanic Serving Institution (HSI).

SWC recognizes the importance of exposing students to nanotechnology because labor market data show that workers skilled in the design, fabrication, and characterization of nanotechnologies are in high demand throughout Southern California and in the manufacturing centers of the United States. However, at present, nanotechnology is not treated as a separate discipline from engineering or chemistry. As a result, sparse dedicated academic opportunities exist to educate and train CCC students in this rapidly expanding field. This is a major reason that nanotechnology should be recognized as a separate field from chemistry or engineering.

SWC enthusiastically supports the expansion and development of nanotechnology education. This October, in collaboration with UC San Diego, SWC will be submitting a proposal to the National Science Foundation for funding to create a certificate program in micro-nano-technology technician education, with myself as the PI.

I have reviewed the 2021 proposal to add nanotechnology to the CCC Minimum Qualifications (MQ) Handbook, which I understand guides faculty hiring. I agree with your assessment that the inclusion of Nanotechnology as an academic discipline is both necessary and long overdue, especially given the growth and importance of the field both nationally and particularly in California.

I am writing to support this proposal. It is essential for nanotechnology to be recognized by the CCC as a separate field in academia, as it is already recognized in industry. The field of nanotechnology has flourished over the past three decades with a rich volume of scholarship, highly accomplished scholars and alumni, and excellent programs at major universities across the country. Numerous institutions in California and all across the US are dedicated to nanoscience and nanotechnology research. For example, the California NanoSystems Institute (CNSI), founded in 2000, is an integrated nanotechnology research center operating jointly at UC Los Angeles and UC Santa Barbara. The Kavli Nanoscience Institute (KNI) was established in 2003 at CalTech.
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I hope that the consideration and support of the CCC Board will be afforded to nanotechnology degrees, certifications, and other indicators of training and education in this growing field. I support my colleagues in the community colleges as they seek this formal recognition for the important work they are already doing.

Sincerely,

Juan Pablo Gonzalez-Gonzalez
Professor of Chemistry
School of Math, Science, and Engineering
Southwestern College
Program Endorsement Brief: 0999.00/Other Engineering and Related Industrial Technologies
Advanced Material Nanotechnology
Los Angeles/Orange County Center of Excellence, March 2021

Summary Analysis

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<th>Program Endorsement:</th>
<th>Endorsed: All Criteria Met</th>
<th>Endorsed: Some Criteria Met</th>
<th>Not Endorsed</th>
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Emerging Occupation(s)

<table>
<thead>
<tr>
<th>Emerging Occupation(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes ✓</td>
</tr>
</tbody>
</table>

The Los Angeles/Orange County Center of Excellence for Labor Market Research (COE) prepared this report to provide Los Angeles/Orange County regional labor market supply and demand data related three middle-skill occupations: industrial engineering technologists and technicians (17-3026); calibration technologists and technicians and engineering technologists and technicians, except drafters, all other (17-3098); and chemical technicians (19-4031). This report also includes one emerging occupation: quality control analysts (19-4099.01). Middle-skill occupations typically require some postsecondary education, but less than a bachelor’s degree. This report is intended to help determine whether there is demand in the local labor market that is not being met by the supply from community college programs that align with the relevant occupations.

Based on the available data, there appears to be a supply gap for these technician occupations related to advanced material nanotechnology in the region. Furthermore, the occupations in this report typically require an associate degree, and entry-level wages exceed the living wage in both Los Angeles and Orange counties. Therefore, due to all the criteria being met, the COE endorses this proposed program. Detailed reasons include:

Demand:

- **Supply Gap Criteria** – Over the next five years, there is projected to be 1,071 jobs available annually in the region due to new job growth and replacements, which is more than the 501 awards conferred annually by educational institutions in the region.

1 The COE classifies middle-skill jobs as the following:

- All occupations that require an educational requirement of some college, associate degree or apprenticeship;
- All occupations that require a bachelor’s degree, but also have more than one-third of their existing labor force with an educational attainment of some college or associate degree; or
- All occupations that require a high school diploma or equivalent or no formal education, but also require short-term to long-term on-the-job training where multiple community colleges have existing programs.
Nanotechnology is an ever-emerging field that combines science, engineering, and technology. Since there are no current standard occupational classification (SOC) codes that track data for technicians solely in the field of nanotechnology, the number of annual job openings is likely overstated.

Over the past 12 months, there were five online job postings for nanotechnology engineering technicians.

- **Living Wage Criteria** – Within Los Angeles County, all occupations related to advanced material nanotechnology have entry-level wages above the county’s living wage ($15.04/hour).

- **Educational Criteria** – The Bureau of Labor Statistics (BLS) lists an associate degree as the typical entry-level education for all of the technician occupations in this report. Furthermore, the national-level educational attainment data indicates between 34.3% and 50.8% of workers in the field have completed some college or an associate degree.

**Supply:**

- There are 15 community colleges in the LA/OC region that issue awards related to the occupations of interest, conferring an average of 323 awards annually between 2016 and 2019.

- Between 2014 and 2017, there was an average of 178 awards conferred annually in related training programs by non-community college institutions throughout the region.

  Similar to disclaimer above for the number of annual job openings being likely overstated for nanotechnology positions, there is no TOP designated specifically for nanotechnology, and no completions reported under the designated CIP code for nanotechnology programs (Nanotechnology – CIP 15.1601). Therefore, the number of awards specifically related to nanotechnology is also overstated.

**Occupational Demand**

Exhibit 1 shows the five-year occupational demand projections for the four occupations related to advanced material nanotechnology. In Los Angeles/Orange County, the number of jobs related to these occupations is projected to increase by 2% through 2024. There will be nearly 1,100 job openings per year through 2024 due to job growth and replacements.

Nanotechnology is an ever-emerging field that combines science, engineering, and technology. Since there are no current standard occupational classification (SOC) codes that track data for technicians solely in the field of nanotechnology, demand data in Exhibit 1 is overstated when considering only technicians in the field of advanced material nanotechnology. Recently, data collection has been underway for emerging nanotechnology technician occupations.

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2 Living wage data was pulled from California Family Needs Calculator on 3/31/2021. For more information, visit the California Family Needs Calculator website: [https://insightcced.org/2018-family-needs-calculator/](https://insightcced.org/2018-family-needs-calculator/).
nanotechnology engineering technicians (17-3029.12), a code which is no longer is use, and nanotechnology engineering technologists and technicians (17-3026.01), the current O*NET (emerging) code. Since this emerging occupation has recently changed, Exhibit 1 includes data for both 17-3026 and 17-3029, in order to capture all relevant demand data.

This report includes employment projection data by Emsi, which uses EDD information. Emsi’s projections are modeled on recorded (historical) employment figures and incorporate several underlying assumptions, including the assumption that the economy, during the projection period, will be at approximately full employment. To the extent that a recession or labor shock, such as the economic effects of COVID-19, can cause long-term structural change, it may impact the projections. At this time, it is not possible to quantify the impact of COVID-19 on projections of industry and occupational employment. Therefore, the projections included in this report do not take the impacts of COVID-19 into account.

Exhibit 1: Occupational demand in Los Angeles and Orange Counties

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles</td>
<td>6,535</td>
<td>6,590</td>
<td>56</td>
<td>1%</td>
<td>711</td>
</tr>
<tr>
<td>Orange</td>
<td>3,164</td>
<td>3,304</td>
<td>139</td>
<td>4%</td>
<td>360</td>
</tr>
<tr>
<td>Total</td>
<td>9,699</td>
<td>9,894</td>
<td>195</td>
<td>2%</td>
<td>1,071</td>
</tr>
</tbody>
</table>

Wages
The labor market endorsement in this report considers the entry-level hourly wages for the occupations related to advanced material nanotechnology in Los Angeles County as they relate to the county’s living wage. Orange County wages are included below in order to provide a complete analysis of the LA/OC region. Detailed wage information, by county, is included in Appendix A.

Los Angeles County— All of the occupations of interest have entry-level wages above the living wage for one adult ($15.04 in Los Angeles County). Typical entry-level hourly wages are in a range between $17.43 and $22.93. Experienced workers can expect to earn wages between $31.74 and $40.84, which are higher than the living wage estimate.

Orange County— All of the occupations of interest have entry-level wages above the living wage for one adult ($17.36 in Orange County). Typical entry-level hourly wages are in a range between $17.60 and $23.84. Experienced workers can expect to earn wages between $30.63 and $43.12, which are higher than the living wage estimate.

Job Postings
There were five online job postings for nanotechnology engineering technicians listed in the past 12 months. The title listed on all five job postings was cleanroom technician. The top skills were cleaning, clean room experience, lifting ability, current good manufacturing practices (CGMP),

---

3 Five-year change represents new job additions to the workforce. Annual openings include new jobs and replacement jobs that result from retirements and separations.
and packaging. The only two employers listed on job postings were TalentZok and Quality Precision Cleaning.

It is important to note that the job postings data included in this section reflects online job postings listed in the past 12 months and does not yet demonstrate the impact of COVID-19. While employers have generally posted fewer online job postings since the beginning of the pandemic, the long-term effects are currently unknown.

**Educational Attainment**

The Bureau of Labor Statistics (BLS) lists an associate degree as the typical entry-level education for all four occupations studied in this report. Furthermore, the national-level educational attainment data indicates between 34.3% and 50.8% of workers in the field have completed some college or an associate degree.

**Educational Supply**

**Community College Supply**—Exhibit 2 shows the annual and three-year average number of awards conferred by community colleges in the related TOP codes: Engineering Technology, General (requires trigonometry) (0924.00), Industrial Electronics (0934.20), Chemical Technology (0954.00), Manufacturing and Industrial Technology (0956.00), and Other Engineering and Related Industrial Technologies (0999.00). The colleges with the most completions in the region are Pasadena and Coastline. Over the past 12 months, there were no other program recommendation requests for nanotechnology programs from regional community colleges.

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>0924.00</td>
<td>Engineering Technology, General (requires Trigonometry)</td>
<td>Cerritos</td>
<td>6</td>
<td>23</td>
<td>26</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East LA</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glendale</td>
<td>12</td>
<td>17</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pasadena</td>
<td>122</td>
<td>173</td>
<td>176</td>
<td>157</td>
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<tr>
<td></td>
<td></td>
<td>LA Subtotal</td>
<td>141</td>
<td>213</td>
<td>216</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Santa Ana</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OC Subtotal</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Supply Subtotal/Average</td>
<td>146</td>
<td>214</td>
<td>217</td>
<td>192</td>
<td></td>
</tr>
<tr>
<td>0934.20</td>
<td>Industrial Electronics</td>
<td>El Camino</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LA Subtotal</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Supply Subtotal/Average</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0954.00</td>
<td>Chemical Technology</td>
<td>LA Trade</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LA Subtotal</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Supply Subtotal/Average</td>
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<td>0</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>0956.00</td>
<td>Cerritos</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compton</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
### Non-Community College Supply

For a comprehensive regional supply analysis, it is important to consider the supply from other institutions in the region that provide training programs for technicians related to advanced material nanotechnology. Exhibit 3 shows the annual and three-year average number of awards conferred by these institutions in the related Classification of Instructional Programs (CIP) Codes: Engineering Technology, General (15.000), Industrial Technology/Technician (15.0612), Manufacturing Engineering Technology/Technician (15.0613), Mechanical Engineering/Mechanical Technology/Technician (15.0805), and Industrial and Product Design (50.0404). Due to different data collection periods, the most recent three-year period of available data is from 2014 to 2017. Between 2014 and 2017, non-community college institutions in the region conferred an average of 178 awards annually in related training programs.

To reiterate, there were no completions reported under the CIP code designated specifically for nanotechnology programs – Nanotechnology, CIP – 15.1601.
Exhibit 3: Regional non-community college awards, 2014-2017

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15.0000</td>
<td>Engineering Technology, General</td>
<td>California State Polytechnic Univ.-Pomona</td>
<td>26</td>
<td>42</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>California State Univ.-Long Beach</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>15.0612</td>
<td>Industrial Technology/Technician</td>
<td>California State Univ.-Los Angeles</td>
<td>34</td>
<td>41</td>
<td>50</td>
<td>42</td>
</tr>
<tr>
<td>15.0613</td>
<td>Manufacturing Engineering Technology/Technician</td>
<td>California State Univ.-Long Beach</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15.0805</td>
<td>Mechanical Engineering/Mechanical Technology/Technician</td>
<td>California State Polytechnic Univ.-Pomona</td>
<td>-</td>
<td>-</td>
<td>41</td>
<td>14</td>
</tr>
<tr>
<td>50.0404</td>
<td>Industrial and Product Design</td>
<td>Argosy University-The Art Institute of California-Hollywood</td>
<td>7</td>
<td>8</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Argosy University-The Art Institute of California-Orange County</td>
<td>20</td>
<td>13</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>California State Univ.-Long Beach</td>
<td>18</td>
<td>21</td>
<td>39</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FIDM-Fashion Institute of Design &amp; Merchandising-Los Angeles</td>
<td>-</td>
<td>-</td>
<td>41</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Otis College of Art and Design</td>
<td>30</td>
<td>24</td>
<td>28</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Supply Total/Average</strong></td>
<td><strong>138</strong></td>
<td><strong>154</strong></td>
<td><strong>243</strong></td>
<td><strong>178</strong></td>
</tr>
</tbody>
</table>
### Exhibit 4. Los Angeles County

<table>
<thead>
<tr>
<th>Occupation (SOC)</th>
<th>2019 Jobs</th>
<th>2024 Jobs</th>
<th>5-Yr Change</th>
<th>5-Yr % Change</th>
<th>Annual Openings</th>
<th>Entry-Level Hourly Earnings (25th Percentile)</th>
<th>Median Hourly Earnings</th>
<th>Experienced Hourly Earnings (75th Percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Engineering Technologists and Technicians (17-3026)</td>
<td>934</td>
<td>920</td>
<td>(14)</td>
<td>(2%)</td>
<td>92</td>
<td>$22.45</td>
<td>$29.82</td>
<td>$40.84</td>
</tr>
<tr>
<td>Calibration Technologists and Technicians and Engineering Technologists and Technicians, ExceptDrafters, All Other (17-3098)</td>
<td>2,120</td>
<td>2,131</td>
<td>12</td>
<td>1%</td>
<td>214</td>
<td>$22.93</td>
<td>$29.53</td>
<td>$39.59</td>
</tr>
<tr>
<td>Chemical Technicians (19-4031)</td>
<td>1,337</td>
<td>1,338</td>
<td>1</td>
<td>0%</td>
<td>136</td>
<td>$17.43</td>
<td>$23.06</td>
<td>$31.74</td>
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<tr>
<td>Life, Physical, and Social Science Technicians, All Other (19-4099)</td>
<td>2,144</td>
<td>2,201</td>
<td>57</td>
<td>3%</td>
<td>269</td>
<td>$18.82</td>
<td>$25.60</td>
<td>$32.13</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>6,535</strong></td>
<td><strong>6,590</strong></td>
<td><strong>56</strong></td>
<td><strong>1%</strong></td>
<td><strong>711</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

### Exhibit 5. Orange County

<table>
<thead>
<tr>
<th>Occupation (SOC)</th>
<th>2019 Jobs</th>
<th>2024 Jobs</th>
<th>5-Yr Change</th>
<th>5-Yr % Change</th>
<th>Annual Openings</th>
<th>Entry-Level Hourly Earnings (25th Percentile)</th>
<th>Median Hourly Earnings</th>
<th>Experienced Hourly Earnings (75th Percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Engineering Technologists and Technicians (17-3026)</td>
<td>575</td>
<td>590</td>
<td>15</td>
<td>3%</td>
<td>59</td>
<td>575</td>
<td>590</td>
<td>15</td>
</tr>
<tr>
<td>Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other (17-3098)</td>
<td>1,089</td>
<td>1,124</td>
<td>34</td>
<td>3%</td>
<td>113</td>
<td>$23.49</td>
<td>$29.95</td>
<td>$39.94</td>
</tr>
<tr>
<td>Chemical Technicians (19-4031)</td>
<td>611</td>
<td>637</td>
<td>25</td>
<td>4%</td>
<td>67</td>
<td>$17.60</td>
<td>$23.29</td>
<td>$32.06</td>
</tr>
<tr>
<td>Life, Physical, and Social Science Technicians, All Other (19-4099)</td>
<td>889</td>
<td>953</td>
<td>65</td>
<td>7%</td>
<td>121</td>
<td>$17.96</td>
<td>$24.41</td>
<td>$30.63</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>3,164</strong></td>
<td><strong>3,304</strong></td>
<td><strong>139</strong></td>
<td><strong>4%</strong></td>
<td><strong>360</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
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</table>
### Exhibit 6. Los Angeles and Orange Counties

<table>
<thead>
<tr>
<th>Occupation (SOC)</th>
<th>2019 Jobs</th>
<th>2024 Jobs</th>
<th>5-Yr Change</th>
<th>5-Yr % Change</th>
<th>Annual Openings</th>
<th>Typical Entry-Level Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Engineering Technologists and Technicians (17-3026)</td>
<td>1,509</td>
<td>1,509</td>
<td>1</td>
<td>0%</td>
<td>151</td>
<td>Associate degree</td>
</tr>
<tr>
<td>Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other (17-3098)</td>
<td>3,209</td>
<td>3,255</td>
<td>46</td>
<td>1%</td>
<td>327</td>
<td>Associate degree</td>
</tr>
<tr>
<td>Chemical Technicians (19-4031)</td>
<td>1,948</td>
<td>1,975</td>
<td>27</td>
<td>1%</td>
<td>203</td>
<td>Associate degree</td>
</tr>
<tr>
<td>Life, Physical, and Social Science Technicians, All Other (19-4099)</td>
<td>3,033</td>
<td>3,154</td>
<td>121</td>
<td>4%</td>
<td>390</td>
<td>Associate degree</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>9,699</strong></td>
<td><strong>9,894</strong></td>
<td><strong>195</strong></td>
<td><strong>2%</strong></td>
<td><strong>1,071</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Appendix B: Sources
- O*NET Online
- Labor Insight/Jobs (Burning Glass)
- Economic Modeling Specialists, International (Emsi)
- Bureau of Labor Statistics (BLS)
- Employment Development Department, Labor Market Information Division, OES
- California Community Colleges Chancellor’s Office Management Information Systems (MIS)
- California Family Needs Calculator, Insight Center for Community Economic Development
- Chancellor’s Office Curriculum Inventory (COCI 2.0)

For more information, please contact:

Luke Meyer, Director
Los Angeles/Orange County Center of Excellence
lmeyer7@mtsac.edu

March 2021
Meeting Minutes

Division: Science

Department: Chemistry

Date: May 21, 2021

Time: 10:00 am

Advisors in Attendance:

- Ari Esters - Cardea Bio (Bio-electronics).
- Juan Flores Preciado - Space X (Aerospace).
- Jared Ashcroft – Pasadena City College (Education).
- Lynn Foster - Z-Field Technologies (Biotechnology); BPT Pharmaceuticals (BioPharmaceutical).
- Marco Curreli – Omni Nano (Nanotechnology Project Consultant and Education Technology Expert).
- Samad Ahadian - Terasaki Institute (Healthcare).
- Sapphire Lopez - Northrop Grumman Corporation (Aerospace and Defense).
- Fabian Villalobos - RAND Corporation (Technology Policies).

Prior to the meeting, every Board Member was provided with a copy of the Course Outline of Records (CORs) for CHEM 240, CHEM 241, and CHEM 242.

Agenda:

The meeting started promptly at 10:00 am on the Zoom platform, and it was moderated by Dr. Marco Curreli. The meeting agenda included:

- Welcome and overview.
- Round table introductions.
- Summary of the program, goals, motivation, courses taught, and skills to be learned in our program.
- Discussion about the technical knowledge, technical skills, and “soft skills” needed by the local “advanced materials” industry.
- Board’s feedback and recommendation on our certificate program.
- Conclusion.
Board's Recommendations:

Our certificate program should provide the following knowledge and skills:

Materials and Devices:

- Ability to processes raw nanomaterials so they can incorporate into an intermediate or final product. Raw nanomaterials (graphene, nanoparticles, etc.) are often processed in a dispersion. Technicians should have the technical skills and knowledge to make these dispersions with an understanding of their long-term stability, fluid properties, and optical properties. These knowledge and skills are taught in CHEM 240.
- Principles of lithographic processes, handling wafers, manufacturing techniques, and device structure. These knowledge and skills are taught in CHEM 241.
- Principles of sensor structure and devices. These knowledge and skills are taught in CHEM 241.
- Prepare interfaces for the integration of biological material on inorganic surfaces, such as scaffolds, electronic devices, dispersed materials. These knowledge and skills are taught in CHEM 240.
- Knowledge of mechanical properties at the nanoscale and metal microstructure. These knowledge and skills are taught in CHEM 240.
- Working principles of energy storing devices, such as batteries and super-capacitors, material requirements, and cell structure. These knowledge and skills are taught in CHEM 241.

Instrumentation and Characterization:

- Working principles of techniques and instrumentations to characterize dispersions of nanomaterials, such as UV/Vis and particle size analyzers. Ability to process raw data into, present results, and interpret those results. These knowledge and skills are taught in CHEM 240 and CHEM 241.
- Sample preparation and testing of composite samples and metal samples via Scanning Electron Microscopy (SEM). Knowledge of SEM working principles and other imaging/characterization techniques. These knowledge and skills are taught in CHEM 240.
- Knowledge and testing of functional devices for energy storage. These knowledge and skills are taught in CHEM 241.
- Quality control on a variety of samples and functional devices. These knowledge and skills are taught in CHEM 240, CHEM 241, and CHEM 242.

Note: No additional instruments or equipment is required by Pasadena City College.

Good Lab Practice:
• General knowledge of “Environmental, Health, & Safety (EHS) related to nanomaterials and nanomanufacturing processes. These knowledge and skills are taught in CHEM 242.
• Creation of proper documentation. These knowledge and skills are taught in CHEM 242.

Soft skills:

• Ability to clearly communicate technical details, discuss results, and write technical reports following a specific format. These knowledge and skills are taught throughout CHEM 240, CHEM 241, and CHEM 242.

Recommendations

• The Board unanimously felt this certificate program would provide graduate students with the technical knowledge and skills that are in demand by “emerging technology” companies in SoCal.
• The Board unanimously felt this certificate program is aligned with the needs of the local “advanced materials & nanotech” industry.

Conclusion

The meeting was adjourned at 11:00 am.