Application for Registration of a New Certificate or Advanced Certificate Program[1]

Program registration is based on standards in the Regulations of the Commissioner of Education. Section 52.1 defines the curricula that must be registered. The Department registers individual curricula rather than the institution as a whole, but the registration process addresses major institutional elements. It is the chief means by which the Regents support the quality of college and university programs.

STOP This application should NOT be used for the following types of program proposals:

- General Academic Programs Leading to a Degree Award (e.g., Bachelor of Arts)
- Programs Preparing Teachers, Educational Leaders, and Other School Personnel;
- Programs Preparing Licensed Professions; or
- Revisions to Existing Registered Programs

The application materials for those types of proposals can be found at:
http://www.highered.nysed.gov/ocue/aipr/register.html

Doctoral programs: please contact the Office of College and University Evaluation.

Directions for submission of proposal:

1. Create a *single* PDF document that includes the following completed forms:

- Application for Registration of a New Certificate or Advanced Certificate Program
- Application to Add the Distance Education Format to a New or Registered Programs (if applicable)
- CEO (or Designee) Approval Form

2. Create a separate PDF document for any required syllabi (see Task 3 for syllabi requirements.)

3. Attach the PDF documents to an e-mail.

4. Send e-mail to **OCUERevAdmin@mail.nysed.gov**

When submitting to the mailbox, include the following elements in the subject line of the e-mail: Institution Name, Degree Award, and Program Title

E.g., Subject: AAA College, Advanced Certificate, English Literature

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[1] CUNY and SUNY institutions: contact System Administration for proposal submission process.

Task 1 Institution and Program Information

Institution Information

Institution Name:	CUNY Lehman College
Institution Code (6 digits): ***The name and code of the institution should reflect the information found on the [Inventory of Registered Programs](#)***	332000
Institution Address:	250 Bedford Park Blvd West
City:	Bronx
State/Country:	New York
Zip:	10468
[Regents Regions](#)*:*	New York City Region
Specify campus(s) of the institution where program is offered, if other than the main campus: ***The name and code of the location(s) should reflect the information found on the [Inventory of Registered Programs](#)***	Main campus
Specify any other additional campus(s) where the program is offered besides the ones selected above:	N/A
If any courses will be offered off campus, indicate the location and number of courses and credits:	N/A
If the program will be registered jointly with another institution, please provide the partner institution's name:	N/A

Program Information for New Programs	
Program Title:	Certificate in Digital Technology and Electronics
Degree Award:	☒ Certificate ☐ Advanced Certificate
HEGIS code:	
Number of Credits*:	23

If the program contains multiple options or concentrations that affect the number of program credits, list the total number of program credits required for each option:

Option/Concentration Name:	Credits:
Option/Concentration Name:	Credits:
Option/Concentration Name:	Credits:
Option/Concentration Name:	Credits:

If program is part of a dual degree program, provide the following information:

Program Title:	
Degree Award:	
HEGIS code:	

Section III. Contact Information	
Name of contact person: Daniel Kabat	
Title of contact person: Professor	
Telephone 718 - 960 - 8773	
Fax: 718 - 960 - 8627	
Email: daniel.kabat@lehman.cuny.edu	

Task 2 - Proposed Program Information

Guidance for this task can be found by clicking here: Department Expectations: Admissions, Academic Support Services, Credit for Experience and Program Assessment and Improvement

Relevant Regulations for this task can be found by clicking here: Relevant Regulations for Task 2

1. Program type *(check one)*

☒ Certificate ☐ Advanced Certificate

2. Program format

Check all scheduling, format, and delivery features that apply to the proposed program. Unless otherwise specified below, it is assumed the proposed program may be completed through a full-time, day schedule. Format definitions can be found by clicking here: Format Definitions

☐	**Evening:** All requirements for the award must be offered during evening study.
☐	**Weekend:** All requirements for the award must be offered during weekend study.
☐	**Evening/Weekend:** All requirements for the award must be offered during a combination of evening and weekend study.
☐	**Day Addition:** For programs having EVENING, WEEKEND, or EVENING/WEEKEND formats, indicates that all requirements for the award can also be completed during traditional daytime study.
☐	**Not Full-Time:** The program cannot be completed on a full-time basis, e.g., an associate degree that cannot be completed within two academic years. Such programs are not eligible for TAP payments to students.
☐	**5-Year baccalaureate:** Indicates that because of the number of credits required, the program is approved as a 5-year program with five-year State student financial aid eligibility.
☐	**4.5 Year baccalaureate:** Indicates that because of the number of credits required, the program is approved as a 4.5-year program with 4.5-year State student financial aid eligibility.
☐	**Upper-Division:** A program comprising the final two years of a baccalaureate program. A student cannot enter such a program as a freshman. The admission level presumes prior completion of the equivalent of two years of college study and substantial prerequisites.
☐	**Independent Study:** A major portion of the requirements for the award must be offered through independent study rather than through traditional classes.
☐	**Cooperative:** The program requires alternating periods of study on campus and related work experience. The pattern may extend the length of the program beyond normal time expectations.
☐	**Distance Education:** 50% or more of the course requirements for the award can be completed through study delivered by distance education.
☐	**External:** All requirements for the award must be capable of completion through examination, without formal classroom study at the institution.
☐	**Accelerated:** The program is offered in an accelerated curricular pattern which provides for early completion. Semester hour requirements in Commissioner's Regulations for instruction and supplementary assignments apply.
☐	**Standard Addition:** For programs having Independent, Distance Education, External, OR Accelerated formats, indicates that all requirements for the award can also be completed in a standard, traditional format.
☐	**Bilingual:** Instruction is given in English and in another language. By program completion, students are proficient in both languages. This is not intended to be used to identify programs in foreign language study.
☐	**Language Other Than English:** The program is taught in a language other than English.
☐	**Other Non-Standard Feature(s):** Please provide a detailed explanation.

3. Related degree program(s)

Indicate the registered degree program(s) by title, award and five-digit SED code to which the credits will apply: Physics, BS, 34031. Computer Science, BS, 89335.

4. Program Description and Purpose

1) Provide a brief description of the program as it will appear in the institution's catalog.
Answer: The Certificate in Digital Technology and Electronics consists of 23 course credits covering electronics and computer programming and organization. The courses, offered by the Department of Physics and Astronomy and the Department of Computer Science, lead to a culminating internship or research experience. The Certificate is intended for
- Science majors, especially those interested in experimental science who need a working knowledge of electronic technology
- Computer science majors who want hands-on experience with electronic circuits and their use in computer architecture and engineering
- Students in the sciences and in other fields interested in careers involving digital technology and electronic devices

The Certificate provides students with a working knowledge of analog and digital circuit design, computer architecture and engineering, and both high-level and machine-level computer programing. Students are given the hands-on experience of working in teams to design, construct and program a functioning computer system.

Seven required courses (23 credits total)
Six courses (20 credits) in required physics and computer science courses:

PHY 165	Applied Physics (5 hours, 4 credits)	
PHY 305	Analog Circuits (4 hours, 3 credits)	
PHY 315	Digital Circuits and Systems (4 hours, 3 credits)	
CMP 167	Programming Methods I (4 hours, 3 credits)	
CMP 267	Programming Methods II (4 hours, 3 credits)	
CMP 334	Computer Organization (4 hours, 4 credits)	

Students may take PHY 167 or PHY 169 in place of PHY 165.
One course (3 credits) in experiential learning:

either	CMP 487	Internship in Computer Science (3 credits)
or	PHY 487	Internship in Physics (3 credits)
or	PHY 489	Honors Course (for 3 credits)

2) List the educational and (if appropriate) career objectives of the program.
Answer: This Certificate program provides training in the theory and practice of electronics and digital technology. It addresses the educational needs and career objectives of many students interested in STEM fields, since digital electronics is foundational for computer science, much of modern engineering and almost all contemporary science experiments. The Certificate provides opportunities for hands-on learning and incorporates a culminating internship or research experience. It opens up career paths involving digital technology and electronics by providing the foundational career-readiness skills of team problem-solving and complex task management.

3) How does the program relate to the institution's mission and/or master plan?
 Answer: This Certificate provides practical training in digital technology and electronics and leads to internship opportunities and new career paths for Lehman graduates. It fits with the goal, articulated in Lehman's Strategic Planning Council Report 2009 - 2019 (http://www.lehman.edu/academics/plan.php), to "Develop, strengthen, and realign programs in emerging fields of knowledge, such as ... STEM disciplines." It aligns with the goal, articulated in the CUNY Master Plan 2016 - 2020 (http://www2.cuny.edu/about/masterplan/), of "Launching new and refreshed academic programs with clear learning outcomes that instill the competencies students need now and address the needs of new and growing industry sectors, particularly in technology fields." It also aligns with the statement made by the Chancellor (http://www1.cuny.edu/sites/news-chancellor/2016/09/a-message-from-the-

chancellor-important-steps-to-renew-cunys-essential-mission/), "We are focused as never before on increasing opportunities for our students to participate in internships and other experiential learning programs to improve employment prospects upon graduation. Among our priorities will be opportunities in growth areas in technology ..."

4) Describe the role of faculty in the program's design.
Answer. This Certificate proposal was developed jointly by the Department of Physics and Astronomy and the Department of Computer Science. The lead faculty were Daniel Kabat in Physics and Brian Murphy and Sameh Fakhouri in Computer Science. Tom Paul, a research associate in Physics, developed the new electronics courses which will be included in the Certificate and was also involved in designing this proposal. The office of the Dean of Natural and Social Sciences was extensively consulted. Indeed the idea for this Certificate grew out of a perceived need for training in digital technology and electronics, as part of a 2015 - 2016 CUNY Strategic Investment Initiative grant which called for the development of interdisciplinary science-based tracks targeted at today's workplace, with opportunities for internships and experiential learning. This grant activity was directed by NSS Associate Dean Dr. Chris Malone.

5) Describe the input by external partners, if any (e.g., employers and institutions offering further education).
Answer. N/A

6) What are the anticipated Year 1 *through* Year 5 enrollments?
Answer. The Certificate is designed to be completed in two years. The additional courses needed can be taken in parallel with the upper-level requirements for degrees in Physics and Computer Science and should not increase time-to-degree. Given the growth in Computer Science in particular, we anticipate the following enrollments.

	Year 1	Year 2	Year 3	Year 4	Year 5
Incoming students	10	10	12	15	15
Total students	10	20	22	27	30

5. Admissions

1) List all *program* admission requirements (or note if identical to the institution's admission requirements).
Answer. Identical to the institution's admission requirements.

2) Describe the process for evaluating exceptions to these requirements.
Answer. N/A

3) How will the institution encourage enrollment by persons from groups historically underrepresented in the discipline or occupation?
Answer. Lehman College is strongly committed to educating under-represented groups. It's worth noting that white non-Hispanic males make up less than 5% of the undergraduate student body. A number of mechanisms are in place to encourage and support enrollment by under-represented groups, which cannot be distinguished from the student body as a whole. This includes efforts by the Freshman Year Initiative to organize course blocks targeted at STEM students and the STEM pipelines to feeder community colleges being developed as part of a recent federal grant awarded to Lehman as a Hispanic Serving Institution. The Certificate program will piggyback on these existing efforts and supplement them with direct outreach to the Lehman community and through advertising targeted at local high schools and community colleges.

6. Academic Support Services

Summarize the academic support services available to help students succeed in the program.

Answer: Lehman College provides a rich variety of academic support services to its students. This includes academic support offered by the Supplemental Instruction program, the SEEK Tutoring Program, the Math Lab and the Science Learning Center. A recent federal HSI-STEM grant will provide math support for all majors and disciplines at Lehman, including this certificate. Faculty involved with the Certificate will build on these efforts by offering guidance and support for enrolled students.

7. Credit for Experience

If this program will grant substantial credit for learning derived from experience, describe the methods of evaluating the learning and the maximum number of credits allowed.

Answer: The Certificate culminates with a 3-credit experiential learning opportunity in which students are expected to obtain experience with digital technology and electronics in a modern work or research environment. Students are required to enroll in either an internship course (CMP 487 or PHY 487) or a research course (PHY 489 for 3 credits). The instructor provides advice, guidance and supervision for the internship or research experience. Students are evaluated based on a written report which they provide to the instructor at the end of the course.

8. Program Assessment and Improvement

Summarize the plan for periodic evaluation of the new program, including the use of data to inform program improvement.

Answer: All of the courses required by the Certificate are also included in either the Computer Science BS or Physics BS programs, for which there are existing assessment and evaluation plans. The Certificate program will be overseen by a committee consisting of the chair of Computer Science, the chair of Physics and Astronomy, and a representative from the Natural and Social Sciences Dean's office. This committee will periodically
- gather data from students, faculty and internship supervisors
- assess and evaluate program success
- make recommendations for program improvement

Task 3 - Sample Program Schedule

NOTE: The sample program schedule is used to determine program eligibility for financial aid.

Guidance for this task can be found by clicking here: [Department Expectations: Curriculum (including Internships, Financial Aid Considerations, and Liberal Arts and Sciences)](#)

Relevant regulations for this task can be found by clicking here: [Relevant Regulations for Task 3](#)

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a). Complete **Table 1**.

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b). If the program will be **offered through a nontraditional schedule**, provide a brief explanation of the schedule, including its impact on financial aid eligibility.
Answer: N/A

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c). For existing courses, enter the **catalog description** of the courses.
Answer:

CMP 167 Programming Methods I
Structured computer programming using a modern high-level programming language. Includes console I/O, data types, variables, control structures, including iteration, arrays, function definitions and calls, parameter passing, functional decomposition, and an introduction to objects. Debugging techniques. PREREQ: MAT 104 or placement by the Department of Mathematics and Computer Science. Note: For students who intend to major in Computer Science, Mathematics, Computer Graphics and Imaging, or the sciences. Some previous computer programming experience is recommended. Not intended for students in Accounting or Computer Information Systems; the technical content is the same as CIS166 but the emphasis is different.

CMP 267 Programming Methods II
Continuation of parameter passing with a focus on devising function definitions and tracing recursive calls. Sorting and searching algorithms and a comparison of their performance. GUI programming. Threads, Exceptions and Exception Handling. Object Oriented Programming techniques. Lab exercises include designing, writing and debugging programs using commercial IDEs. PREREQ: A grade of B- or better in CMP 167 or Departmental permission. CIS 166 may be used as a PREREQ with Department Permission.

CMP 334 Computer Organization
Introduction to digital logic-expressions, gates, flip-flops, adders. busses, multiplexers Introduction to assembly language and assembly level organization - data representation, instruction formats, addressing modes, interrupts. Memory systems - caches (mapping and management policies) and memory hierarchies, latency and bandwidth, virtual memory (pagetables, TLB). Input/Output- busses, channels and DMA. Performance considerations- pipelining, RISC architecture, branch prediction, introduction to instruction level parallelism. PREREQ: CMP 167 and CMP 232 or Departmental permission.

CMP 487 Internship in Computer Science
(maximum 6 credits). On-the-job training in a public or private institution. PREREQ: Prior approval of Department Chair. Note: Not allowed for credit toward the B.A. in Computer Science.

PHY 489 Honors Course
Independent study or participation in a research project under faculty direction. Credits: One semester, 6 or 9 hours, 2 or 3 credits (maximum 8 credits). PREREQ: Departmental permission.

d). Syllabi:

Provide syllabi for all new courses. The expected components of a syllabus are listed in [Department Expectations: Curriculum](#).

Note: Although it is required to submit syllabi for all new courses as noted, syllabi for *all* courses required for the proposed program should be available upon request.

Instructions for submitting syllabi:

All required syllabi must be included in a single, separate PDF document.
Answer:
Syllabi for PHY 165, PHY 305, PHY 315 and PHY 487 are being submitted separately.

Table 1: Certificate/Advanced Certificate Program Schedule

- Indicate **academic calendar** type: ☒ Semester ☐ Quarter ☐ Trimester ☐ Other (describe):
- Label each term in sequence, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
- Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.

Term: Fall 1				Term: Spring 1			
Course Number & Title	Credits	New	Prerequisite(s)	**Course Number & Title**	Credits	New	Prerequisite(s)
CMP 167 Programming Methods I	3	☐	MAT 104 or placement	CMP 267 Programming Methods II	3	☐	A grade of B- or better in CMP 167 or departmental permission. CIS 166 may be used as a prereq with department permission.
		☐		PHY 165 Applied Physics	4	☒	MAT 175
		☐				☐	
		☐				☐	
		☐				☐	
		☐				☐	
Term credit total:	3			Term credit total:	7		
Term: Fall 2				**Term: Spring 2**			
Course Number & Title	Credits	New	Prerequisite(s)	**Course Number & Title**	Credits	New	Prerequisite(s)
CMP 334 Computer Organization	4	☐	CMP 167 and CMP 232 or departmental permission	CMP 487 Internship in Computer Science / PHY 487 Internship in Physics (new) / PHY 489 Honors Course	3	☒	department consent
PHY 305 Analog Circuits	3	☒	PHY 165 or PHY 167 or PHY 169	PHY 315 Digital Circuits and Systems	3	☒	PHY 305 and CMP 334 or departmental permission
		☐				☐	
		☐				☐	
		☐				☐	
		☐				☐	
Term credit total:	7			Term credit total:	6		
Term:				**Term:**			
Course Number & Title	Credits	New	Prerequisite(s)	**Course Number & Title**	Credits	New	Prerequisite(s)
		☐				☐	
		☐				☐	
		☐				☐	
		☐				☐	
		☐				☐	
		☐				☐	
Term credit total:				Term credit total:			
Term:				**Term:**			
Course Number & Title	Credits	New	Prerequisite(s)	**Course Number & Title**	Credits	New	Prerequisite(s)
		☐				☐	
		☐				☐	
		☐				☐	
		☐				☐	

	☐				☐	
	☐				☐	
Term credit total:				Term credit total:		

Program Totals:	Credits: 23	

New: indicate if new course   **Prerequisite(s)**: list prerequisite(s) for the noted course

Task 4. Faculty

Guidance for this task can be found by clicking here: Department Expectations: Faculty

Relevant regulations for this task can be found by clicking here: Relevant Regulations for Task 4

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a) **Complete the faculty tables** that describe faculty (**Table 2 and Table 3**), and faculty to be hired (**Table 4**), as applicable. Faculty curricula vitae should be provided only by request.

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b) **What is the institution's definition of "full-time" faculty?** Include the number of credits expected to be taught by full-time faculty per academic term.

Answer: A full-time teaching load is 21 contact hours per year for Professorial titles and 27 contact hours per year for Lecturer titles.

Table 2: Current Faculty, Full-Time

- Provide information on faculty members who are full-time at the institution and who will be teaching each course in the major field or graduate program. *Include and identify the Program Director.

Faculty Member Name and Title/Rank at Institution (include and identify Program Director)	Expected Program Course Assignments	Percent of Teaching Time to Program	Highest and Other Applicable Earned Degrees and Disciplines (include College/University)	Additional Qualifications: list related certifications/licenses; professional experience in field, scholarly contributions, other academic affiliations.
Daniel Kabat Professor Program Director	PHY 165 Applied Physics PHY 487 Internship in Physics PHY 489 Honors Course	25%	Ph.D., Physics, MIT	
Brian Murphy Associate Professor	CMP 167 Programming Methods I CMP 267 Programming Methods II	15%	Ph.D., Computer Science, CUNY	
Sameh Fakhouri Lecturer	CMP 167 Programming Methods I CMP 267 Programming Methods II CMP 487 Internship in Computer Science	25%	M.S., Computer Science, NYU	

Faculty Member Name and Title/Rank at Institution (include and identify Program Director)	Expected Program Course Assignments	Percent of Teaching Time to Program	Highest and Other Applicable Earned Degrees and Disciplines (include College/University)	Additional Qualifications: list related certifications/licenses; professional experience in field, scholarly contributions, other academic affiliations.

Table 3: Current Faculty, Part-Time

Provide information on faculty members who are part-time at the institution and who will be teaching each course in the major field or graduate program.

Faculty Member Name and Title/Rank at Institution (include and identify Program Director)	Program Courses which may be Taught	Highest and Other Applicable Earned Degrees and Disciplines (include College/University)	Additional Qualifications: list related certifications/licenses; professional experience in field, scholarly contributions, other academic affiliations.
Tom Paul	PHY 305 Analog Circuits PHY 315 Digital Circuits and Systems	Ph.D., Physics, Johns Hopkins	
Anthony Cocchi	CMP 334 Computer Organization	M.S., Computer Science, Polytechnic University (now New York University Tandon School of Engineering)	35 years of work experience at IBM / IBM Research
Bowen Alpern	CMP 334 Computer Organization	Ph.D., Computer Science, Cornell University	25 years of work experience at IBM Research
Eva Sofianos	CMP 167 Programming Methods I CMP 267 Programming Methods II	M.S., Computer Science, Lehman College	more than a decade of work experience at IBM / IBM Research

Faculty Member Name and Title/Rank at Institution (include and identify Program Director)	Program Courses which may be Taught	Highest and Other Applicable Earned Degrees and Disciplines (include College/University)	Additional Qualifications: list related certifications/licenses; professional experience in field, scholarly contributions, other academic affiliations.

Faculty Member Name and Title/Rank at Institution (include and identify Program Director)	Program Courses which may be Taught	Highest and Other Applicable Earned Degrees and Disciplines (include College/University)	Additional Qualifications: list related certifications/licenses; professional experience in field, scholarly contributions, other academic affiliations.

Table 4: Faculty to be Hired

- If faculty must be hired to teach in the proposed program, specify the title/rank of each new position, the number of new positions, full-time or part-time status, a listing of the expected course assignments for each position, and the expected hiring date.
- Position descriptions and/or announcements may also be submitted.
- Prior to offering the assigned courses, the Department must be notified that a faculty meeting the requirements has been hired.
- These proposed faculty should be reflected in Task 5, Table 4, New Resources

Full-time Faculty

Title/Rank of Position	# of New Positions	Minimum Qualifications (including degree and discipline area)	Expected Course Assignments	Expected Hiring Date (mm/dd/yyyy)
N/A				

Part-time Faculty

Title/Rank of Position	# of New Positions	Minimum Qualifications (including degree and discipline area)	Expected Course Assignments	Expected Hiring Date (mm/dd/yyyy)
N/A				

Task 5. Financial Resources and Instructional Facilities

Guidance for this task can be found by clicking here: Department Expectations: Financial Resources and Instructional Facilities

Relevant Regulations for this task can be found by clicking here: Relevant Regulations for Task 5

a) Summarize the instructional facilities and equipment committed to ensure the success of the program.

Answer: The Certificate builds on several successful courses CMP 167, 267, 334, 487 that lead to degrees in Computer Science. It incorporates a new introductory physics course PHY 165 which can be accommodated in existing instructional facilities in the Department of Physics and Astronomy. Two new electronics courses PHY 305 and 315 are being developed for this Certificate. Space for an electronics lab has been secured in Gillet Hall and the necessary lab equipment has been purchased through funds provided by the NSS Dean's office.

b) Complete the new resources table (**Table 4**).

Not Applicable: ☐

Table 5: New Resources

List the costs of the **new** resources that will be engaged specifically as a result of the new program (e.g., a new faculty position or additional library resources). New resources for a given year should be carried over to the following year(s), with adjustments for inflation, if they represent a continuing cost.

New Expenditures	Year 1	Year 2	Year 3
Personnel			
Library			
Equipment	1000	1000	1000
Laboratories			
Supplies & Expenses (Other Than Personal Service)			
Capital Expenditures			
Other			
Total all	**1000**	**1000**	**1000**

Task 6. Library Resources

Guidance for this task can be found by clicking here: Department Expectations: Library Resources

Relevant regulations for this task can be found by clicking here: Relevant Regulations for Task 6

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a) **Summarize the analysis of library resources *for this program* by the collection librarian and program faculty. Include an assessment of existing library resources and their accessibility to students.**

Answer: Existing library facilities adequately meet the needs of this program.

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b) **Describe the institution's response to identified needs and its plan for library development**.

Answer: N/A

**LEHMAN COLLEGE
OF THE
CITY UNIVERSITY OF NEW YORK**

DEPARTMENT OF COMPUTER SCIENCE
DEPARTMENT OF PHYSICS AND ASTRONOMY

CURRICULUM CHANGE

Name of Program and Degree Award: Digital Technology and Electronics, Certificate
Effective Term: Spring 2019

1. **Type of Change:** New Certificate Program

2. **Certificate in Digital Technology and Electronics**

The Certificate in Digital Technology and Electronics consists of 23 course credits covering electronics and computer programming and organization. The courses, offered by the Department of Physics and Astronomy and the Department of Computer Science, lead to a culminating internship or research experience. The Certificate is intended for
   ▪ Science majors, especially those interested in experimental science who need a working knowledge of electronic technology
   ▪ Computer science majors who want hands-on experience with electronic circuits and their use in computer architecture and engineering
   ▪ Students in the sciences and in other fields interested in careers involving digital technology and electronic devices
The Certificate provides students with a working knowledge of analog and digital circuit design, computer architecture and engineering, and both high-level and machine-level computer programing. Students are given the hands-on experience of working in teams to design, construct and program a functioning computer system.

Seven required courses (23 credits total)
Six courses (20 credits) in required physics and computer science courses:

PHY 165*	Applied Physics	(5 hours, 4 credits)
PHY 305	Analog Circuits	(4 hours, 3 credits)
PHY 315	Digital Circuits and Systems	(4 hours, 3 credits)
CMP 167	Programming Methods I	(4 hours, 3 credits)
CMP 267	Programming Methods II	(4 hours, 3 credits)
CMP 334	Computer Organization	(4 hours, 4 credits)

*Students may take PHY 167 or PHY 169 in place of PHY 165.
One course (3 credits) in experiential learning:

either	CMP 487	Internship in Computer Science	(3 credits)
or	PHY 487	Internship in Physics	(3 credits)
or	PHY 489	Honors Course	(for 3 credits)

3. **Rationale:**

Lehman has seen significant growth in the number of students interested in STEM fields. This growth has occurred across the board, in physics and the natural sciences but most strikingly in computer science. There has also been a steady increase in the number of Lehman students who wish to pursue engineering degrees. This Certificate program takes a step towards addressing the educational needs and career objectives of many of these students, since digital electronics is foundational for computer science, much of modern engineering and almost all contemporary science experiments. The Certificate provides opportunities for hands-on learning and incorporates an internship or research experience. It opens up career paths involving digital technology and electronics by combining the theory and practice of electronics and digital technology and providing the foundational career-readiness skills of team problem-solving and complex task management. Note: CMP 334 has as prerequisites CMP 167 and CMP 232 or departmental permission. CMP 232 has not been included in the certificate since much of the discrete math it covers is not required for electronics. Students will be granted departmental permission as needed so they do not have to take CMP 232.

4. **Date of departmental approval:**
Computer Science: October 17, 2017
Physics and Astronomy: August 30, 2017