

NORTH CAROLINA ENGINEERING PATHWAYS

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Abstract

The North Carolina Engineering Pathways is a joint project of the North Carolina Community College System and five University of North Carolina system schools that have engineering programs. Thirty-four of the fifty-eight community colleges in North Carolina have the Associates in Engineering degree (AE). Starting with grant money from the Golden Leaf Foundation in 2010, NC Engineering Pathways' (NC-EP) main objective is to build and develop pathways for students to begin engineering studies at a community college and then transfer as seamlessly as possible to one of the UNC engineering Universities.

NC-EP's strategic vision is to broaden access to Engineering degrees by; clarifying pathways, courses, and enhancing articulation between institutions and build supportive, long term partnerships with other Community Colleges and Universities.¹ The strong partnership strengthens the Associates in Engineering degree thus creating for minorities, females, and first-generation college students, a firm foundation on which to launch their Engineering career.

Key Words

Advising, Community College, transfer students, Engineering, Engineering Pathways

History

An initial meeting in 2008 was convened at NC A&T by Drs. Kauffmann (ECU) and Lavelle (NCSU). Deans from all four of the UNC engineering schools (Western Carolina University was added later) and representatives from several community colleges agreed to work together to review and refine the Associates in Science Pre-major in Engineering degree and to collaborate on course materials, delivery, and assessment.²

Full funding from the Golden Leaf Foundation for *Building Engineering Pathways Grant* was secured in 2010. Development started on key foundation courses, EGR 150, Introduction to Engineering, PHY 251, 252 General Physics I and II and EGR 220, Engineering Statics. Groups of three to five faculty members from both institutions worked on the individual courses. Complete course materials were written. For example, EGR 220 Statics, syllabi, student learning objectives, problems, labs, videos, textbook selection and links to other resources were created with the course lead from NCSU. These resources enable a community college instructor to implement them and feel confident that they are teaching to the rigors equal to the University level. The whole purpose of redesigning these foundation courses is to make sure that no matter what Community College the student attends, the same topics are covered. After all, the Community College Engineering student, who pays for these courses, will transfer to the University with the same background as the native student population. Curriculum alignment

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helps promote the streamlining of educational requirements and expectations across both the Community Colleges and the Universities in North Carolina.³

The name of the Golden Leaf grant, *Building Engineering Pathways*, was not descriptive enough for a State-wide initiative, as the North Carolina Community College System (NCCCS) wanted to promote Engineering across the State. Hence, the name was changed to the “North Carolina Engineering Pathways (NC-EP)”.

The course resource materials were made available on the website, *NC Engineering Pathways*. The website, <https://www.ncengineeringpathways.org/> is shown in Figure 1.



Figure 1: NC-EP website

More materials were being shared, contributed by Universities and different Community Colleges. Courses taught are shown in Figure 2. Example of a course topic and resources for EGR 220 is shown in Figure 3.

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HOME	NCCCS PROGRAMS	UNC PROGRAMS	CAREERS	COURSES	MOODLE	CONTACT US									
Home » Courses															
<h3 style="margin: 0;">Courses</h3> <p>In general, course work required for an engineering degree consists of three groups. The first involves general education course such as English, humanities and similar categories. Completion of your AA, AS or transfer diploma will fulfill these requirements at the UNC engineering programs. Beyond general education, engineering requires advanced science and mathematics courses such as calculus based physics and calculus through differential equations. Finally there are your engineering courses. These columns list which NCCCS schools offer the last two categories since every community college offers the needed general education.</p> <ul style="list-style-type: none"> • Engineering Courses: Depending on the engineering discipline, in general it is best to complete EGR 150 (introduction to Engineering, EGR 220 Engineering statics, and DFT 170 (engineering graphics) prior to moving to a UNC program. • Calculus based physics: this is a two semester sequence comprised of PHY 251 and 252. In general they are often prerequisites for many engineering courses at the UNC programs. As a result, it is best to complete these prior to enrollment at a UNC program. • Mathematics: Engineering programs grant mathematics credit beginning with calculus I. Pre calculus and college algebra credits are not a part of engineering degree courses. Since MAT 271 (calculus I), MAT 272 (calculus II), MAT 273 (calculus III), and MAT 285 (differential equations) are often prerequisites for engineering courses, it is important to complete these prior to enrollment at the UNC engineering program. Often in areas like industrial and electrical engineering, MAT 280 (linear algebra) is also required. 															
<h4 style="margin: 0;">Engineering Course</h4> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 33%; padding: 5px;"> EGR 150 Intro to Engineering This course is an overview of the engineering profession. Topics include goal setting and career assessment, ethics, public safety, the engineering...read more </td> <td style="width: 33%; padding: 5px;"> EGR 220 Engineering Statics This course introduces the concepts of engineering based on forces in equilibrium. Topics include concentrated forces, distributed forces, forces due...read more </td> <td style="width: 33%; padding: 5px;"> DFT 170 Engineering Graphics This course introduces basic engineering graphics skills and applications. Topics include sketching, selection and use of current methods and tools...read more </td> </tr> <tr> <td style="padding: 5px;"> EGR 212 Logic System Design I This course provides an introduction to digital circuits and analysis. Topics include Boolean Algebra; mixed logic; design of combinational circuits...read more </td> <td style="padding: 5px;"> EGR-215 Network Theory I This course provides an introduction to Kirchoff's laws and terminal equations, circuit analysis techniques and network theorems, transient and...read more </td> <td style="padding: 5px;"> EGR-216 Logic and Network Lab This course provides laboratory experiments in network measurements and logic design and laboratory equipment and techniques. Topics include network...read more </td> </tr> <tr> <td style="padding: 5px;"> EGR-225 Engineering Dynamics This course introduces the concepts of engineering based on the analysis of motion in Cartesian, cylindrical, and spherical coordinate systems...read more </td> <td></td> <td></td> </tr> </tbody> </table>							EGR 150 Intro to Engineering This course is an overview of the engineering profession. Topics include goal setting and career assessment, ethics, public safety, the engineering... read more	EGR 220 Engineering Statics This course introduces the concepts of engineering based on forces in equilibrium. Topics include concentrated forces, distributed forces, forces due... read more	DFT 170 Engineering Graphics This course introduces basic engineering graphics skills and applications. Topics include sketching, selection and use of current methods and tools... read more	EGR 212 Logic System Design I This course provides an introduction to digital circuits and analysis. Topics include Boolean Algebra; mixed logic; design of combinational circuits... read more	EGR-215 Network Theory I This course provides an introduction to Kirchoff's laws and terminal equations, circuit analysis techniques and network theorems, transient and... read more	EGR-216 Logic and Network Lab This course provides laboratory experiments in network measurements and logic design and laboratory equipment and techniques. Topics include network... read more	EGR-225 Engineering Dynamics This course introduces the concepts of engineering based on the analysis of motion in Cartesian, cylindrical, and spherical coordinate systems... read more		
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Figure 2: Associates in Engineering Courses

Topic 7

Class 7: Moments

Reading: 4.1 - 4.4

Suggested Homework: 4-5, 4-9, 4-12, 4-24, 4-26, 4-30, 4-42, 4-46

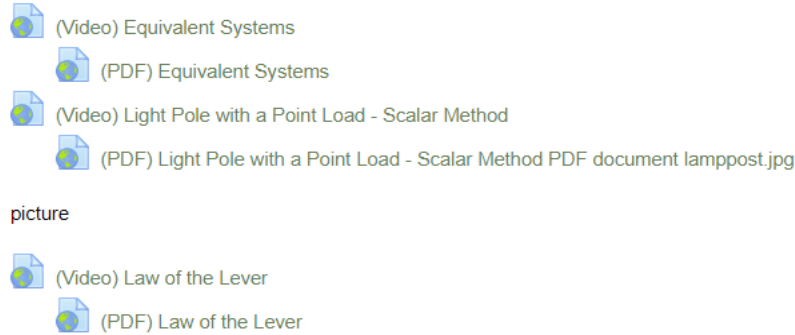


Figure 3. EGR 220 Statics Course Material Example

As Community Colleges offering the AE degree grew from 15 to 34, the objectives for NC-EP, were more focused.

- Encourage growth of high level mathematics and science courses along with freshman and sophomore engineering courses in the community colleges.
- Serve as a communication tool for students interested in engineering careers.
- Provide information on course offerings at the regional Community Colleges to guide students to take the necessary courses for their selected Engineering discipline.
- Provide course materials for NCCCS programs and faculty offering the Introduction to Engineering, Engineering graphics, Engineering statics in conjunction with the Calculus and Science courses.¹

The initial meetings were held at NCSU. More regional Community Colleges were offering the AE degree across the State. To foster collaboration, it was decided that beginning in eastern NC and moving west, an Engineering University and a nearby Community College would host the semi-annual Fall and Spring meeting.

Because students are taking key foundation engineering courses such as Intro to Engineering, Engineering Statics, Engineering Dynamics, and Engineering Graphics at community colleges, more qualified, and better prepared students are completing the AE degree and transferring. NC-EP collaborative efforts have empowered minorities, females, and first-generation college students, to earn an AE degree and to enter a University Engineering program. As an example, the graph in Figure 4 shows the Wake Technical Community College transfer growth.

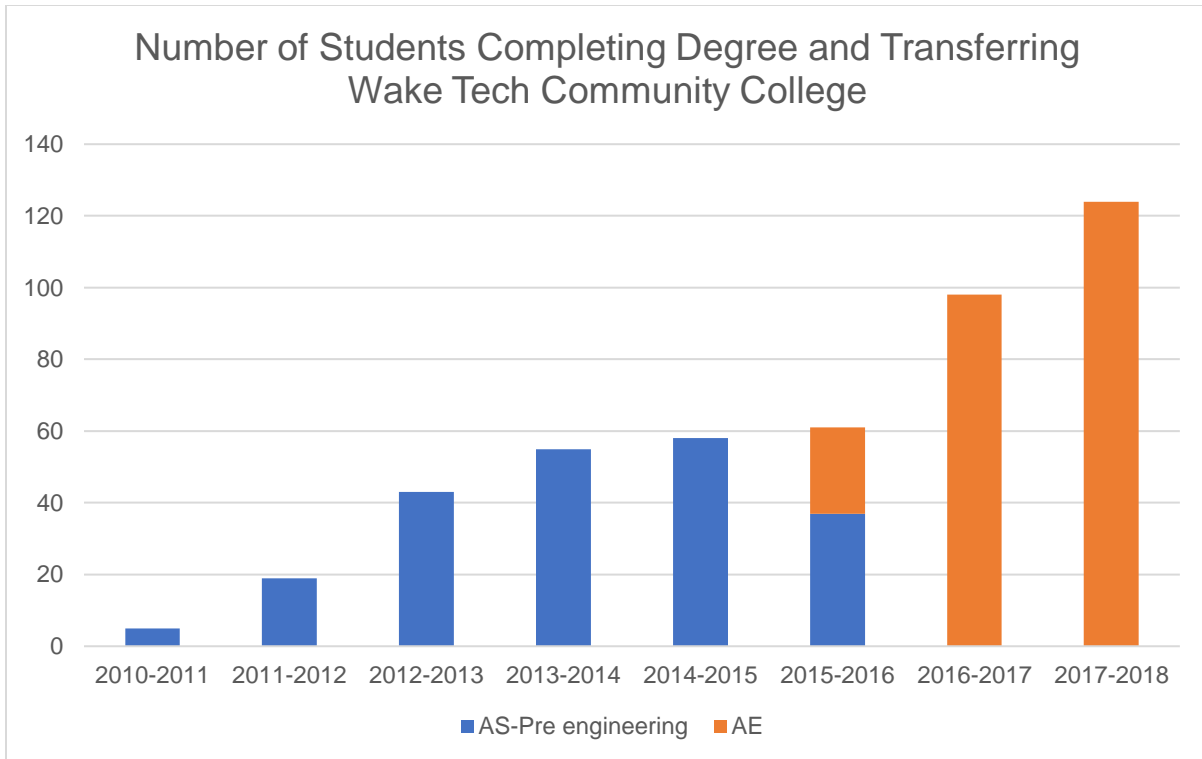


Figure 4. Wake Tech Engineering AE Transfer Numbers Graph

The Associate in Engineering to Bachelor of Science in Engineering Articulation Agreement (AE to BSE AA) was signed by the Community College System and the UNC Board of Governors in February 2015. No longer was the Engineering degree under the Associate of Science but now was its own entity. The AE degree is very prescriptive, starting at Calculus 1, laying a foundation of freshman and sophomore classes taught by the Community College. This agreement applies to all NC community colleges that operate the AE program and to UNC constituent institutions (ECU, NC A&T, NCSU, UNC-Charlotte and Western Carolina.).²

Meetings

NC-EP meetings cover the entire State, from East Carolina University/Pitt Community College to Western Carolina University/AB Tech. The meetings are not only informational but collaborative. This is a good time to network, share strategies, explore new initiatives, discuss pedagogy, methodology or changes in the AE or BSE curriculums.

The first day of the meeting is at the host University. The agenda is an open forum where Engineering disciplines are highlighted, pre-requisite co-requisites are discussed and any or all questions are answered. New perspectives are gained from this exchange of information. These discussions add to the Community College Engineering faculty member's knowledge of that University which is later passed on during a student's advising session. This is current and valuable guidance for the student. For instance, sharing that a student who transferred into computer science at a smaller University is able to work on biometric undergraduate research

with a stipend. The awareness of the scholarships, internships, and other opportunities is essential information to inform the AE Community College student. Tours of the University's facilities create a motivating atmosphere to share with other faculty and students at their home institution. The tours include meeting with various research professors and former community college transfer students who share their accomplishments. The other plus to this day at the University is that connections are made with Deans, Assistant Deans and Department Heads of Engineering disciplines. These networking connections are indispensable resources valued by both University and Community College NC-EP members. Any member can contact another member and get answers because of relationships fostered at these meetings.

The second day is at the nearby hosting Community College. The morning session includes presentations on topics, usually associated with the NCCCS, discussions on changes that need to be made to the Associates in Engineering curriculum, such as adding Geology or removing a course that does not transfer. The Engineering Universities routinely attend the second day, offering insights and direction to the discussions. This exchange of ideas gives the University partners opportunities to clarify and question any Community College methodology or pedagogy of the key foundation courses or new courses being developed.

Collaboration

NC-EP made up of University and Community College representatives have a collegial, respectful, trusting and collaborative relationship. Community College faculty teaching courses in the AE degree, work in partnership with the University professors to build curricular alignment at both institutions. Examination of student learning objectives leads to revising course content that reflect the rigor, expectations and the student knowledge for that course.³ Universities have shared entire course packs, labs and setups with the Community College representatives. Members of NC-EP have been able to sit in on courses at the University to see how the course is taught and what resources are being used. It is a win-win for the Community College, the transfer student, and the University receiving a knowledgeable student that is prepared to complete a Bachelor of Science in Engineering degree.

Conclusion

Partnerships in the US between Community Colleges and Universities have been in existence for years. The North Carolina Engineering Pathways is a unique entity because it encompasses all institutions in the State that have the AE and BSE degree. It allows a Community College student to save money, be guided/advised on the courses to take for the selected engineering discipline, learn in a smaller classroom setting, and have easy access to instructors the first two years. As more community colleges and their four-year University counterparts collaborate to prepare, guide and support students, the more successful these transfers (and these students) can be.⁴ A greater number of minorities, females, and first-generation college students will be able to launch their Engineering career.

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- 1 NC Engineering Pathways website *Constitution North Carolina Two Year College and University Engineering Pathways Ratified Spring 2016*. Retrieved from <http://moodle.ncengineeringpathways.org/mod/resource/view.php?id=1148>
- 2 Associate in Engineering—A Pathway to Success, CTPA. Presentation 2014. Retrieved from <https://www.officialctpa.net/.../Associate%20of%20Engineering%20SP16.pptx>
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Biography

Muffy Vestal, MS Nuclear Engineering

Muffy Vestal is the Coordinator/Instructor of Engineering at Durham Technical Community College. Muffy is a member of ASEE, President of the North Carolina Engineering Pathways. Major Interest: Engineering Education, Mathematics, Nanotechnology. Muffy is an advocate for diversity and opportunities for minorities, women, and first-generation college graduates.

Susan Meardon, MSEE

Susan Meardon is the Department Head for Engineering at Wake Technical Community College. Susan is a member of ASEE, AE BSE TC and North Carolina Engineering Pathways. Major Interest: The future of Engineering, Mechatronics, Nanoengineering, Engineering Education and Neuroscience. Susan has long been a champion of comprehensive advising and has created many documents to streamline the process.