University of New Mexico (UNM) Electrical and Computer Engineering (ECE) academic program review.

I. Introduction

The ECE academic program review on-campus visit took place on February 23 through February 25 and included meetings with many constituencies including students, faculty, staff and several levels of administration such as the leadership of the ECE department, School of Engineering, Office of the Vice President for Research and Provost. The final itinerary of the visit is reproduced as Appendix 1 of this report. The review team members (listed below) express their appreciation for the thorough ECE self-study, for the hospitality of ECE and UNM as well as for the high level of responsiveness and access provided by the ECE department in addressing the team's questions during the visit.

Review Team members:
Stephen M. Phillips, (scribe and chair)
Chair of the School of Electrical, Computer and Energy Engineering
Professor of Electrical Engineering
Arizona State University

Mark J.T. Smith,
Dean of the Graduate School
Michael J. and Katherine R. Birck Professor of Electrical and Computer Engineering
Purdue University

Mark Spong
Dean of the Erik Jonsson School of Engineering and Computer Science
Lars Magnus Ericsson Chair Professor Electrical Engineering
University of Texas at Dallas

Ed Angel (internal)
Director of the Art, Research, Technology and Science (ARTS) Laboratory
Professor Emeritus of Computer Science
University of New Mexico

The remainder of this report is organized as follows. Section II contains a summary of the purpose of the review as well as general university policies provided to the team. Section III includes the ECE-specific questions to be addressed by the team. General observations based on the self-study and visit are in Section IV and responses to the ECE-specific questions are in Section V. Section VI provides some concluding remarks and recommendations.

II. Purpose and University Policies

According to documents provided to the review team, the academic program review provides an opportunity for all academic programs at UNM to examine their achievements and goals. The review will evaluate the quality of the program and describe how it serves other parts of the university, its discipline and the state.

In 1994, the Senate Graduate Committee and the Senate Undergraduate Committee of the Faculty Senate approved a revision of the "Unit Review Guidelines" to include undergraduate programs where appropriate. In 2002, the commitment and support to include undergraduate education was reinforced by the Provost, and these revised guidelines reflect that inclusion.

Guiding principles for the review

1. The program review process is based on short- and long-term planning for the future, rather than merely evaluating current or past practices.
2. The program review process will facilitate increased collaboration and coordination with other campus programs and constituents.
3. The self-study document will define the unit's goals and strategy for moving towards those goals in terms that are consistent with the mission and strategic plan of the unit and of the university.
4. An action plan will be generated as a direct response to the entire review process and will include a mid-point assessment of accomplishments.
5. Academic Program Review is one part of UNM's comprehensive plan for accountability. The results of the reviews will be considered along with other measure of institutional effectiveness.

Final External Review Team Report

It is anticipated that the review team, under the leadership of an elected chair, will provide a final report within six weeks following their visit. The final report will be sent to the unit head and APR Specialist. The APR Specialist will distribute the final report to the campus constituencies for review in preparation for the post-review campus meeting.

The review team is encouraged to comment on any aspect of the unit deemed to be important for program quality and future development. It is useful to begin the report with an overall view of the unit and conclude with a summary which includes specific recommendations. Consider whether activities of the unit are consistent with the stated mission and goals.

Here are some general points to be considered in the final report:

1. The overall quality of the unit based on both regional and national standards
2. The unit's contribution and mission as related to the strategic directions of UNM
3. Impact and visibility of instructional programs

4. Profile and distinction of faculty and students
5. Student success and learning outcomes
6. Contributions to other academic units and collaborative initiatives
7. Community service and experiential learning opportunities
8. Opportunities for further development
9. Appropriateness of short- and long-term goals
10. Implications for accreditation, where appropriate

The review team was also provided with the following list of ECE-specific questions to be addressed during the review.

III. Questions for Review Team: <u>replacing pages 7 and 8 of ECE's Self-Study</u>

1. In recent years interdisciplinary programs have increased across departments, colleges and schools. While the research problems and interests of our faculty have supported the creation of such programs, the current institutional structure, including resource and workload allocations, is built around departments. The issue was highlighted in the recent National Research Council study where a number of ECE faculty, their PhD students, their funding, and their papers were counted under the Optical Sciences and Engineering program (which happened to be listed under the Physics department).

How should we adapt to the increasing demands of interdisciplinary programs?

2. A recent audit of UNM's research office has resulted in a reduced amount of overhead funds now returned to PI's and their departments. The ECE department has relied heavily on that overhead for faculty start-up funds and graduate student recruitment. The current national economic downturn is pressuring budgets even further.

Under increasing funding constraints, how can we come up with creative and sustainable plans for faculty hiring and graduate student recruitment?

3. With the National Academy of Engineering publication of their report on Educating the Engineer of 2020, engineering educators have scrambled to expand the education of students to include a knowledge of innovation, entrepreneurship, IP development, tech transfer, etc. There is a general feeling that a basic body of knowledge needs to be included but reasonable people have different notions of what is basic.

How might we modify our undergraduate programs to respond to increasing demands for breadth of knowledge in new areas? And how can we reward faculty members who are involved in these new areas like IP generation and tech transfer?

4. Nationwide, many institutions are responding to the need to increase the number of scientists in STEM disciplines and to improve the quality and number of scientist and engineers to supply the ever increasing demand for these professionals.

What initiatives would you recommend, either at the school or university level, that could help us increase the number of students studying engineering at UNM?

5. The ECE department received $12 million in grants in the year 2007. While the UNM research office has recently undergone various positive re-organizations, the department faculty and staff remain concerned about the level of support from the university research administration both in terms of returns as well as the ability of the research administration staff to respond in a timely fashion to the changing funding landscape. Moreover, and due to the changing nature of funding (more industry-based), intellectual property issues are consuming an ever-larger portion of faculty and departmental time.

What initiatives would you recommend, either at the school or university level, to reduce bureaucracy and focus the faculty's efforts on securing funding and doing research?

6. **What concrete steps would you recommend to help us to improve our program rankings?**

Section IV General Observations

The general observations are organized with comments about the undergraduate programs first, followed by those regarding the graduate programs, department administration, and university level issues.

A1. Undergraduate programs
The undergraduate program review was performed with an eye towards next year's ABET visit for the Electrical Engineering (EE) and Computer Engineering (CE) programs as well as an internal recommendation perspective.

Observations common to both undergraduate programs:
Undergraduate advising is seen as strong with useful input from both faculty advisors and the professional ECE advisor. Students are satisfied with the advising. The stated ABET program educational objectives should be reviewed to ensure that they more completely meet the ABET requirements (e.g. expected measurable accomplishments of graduates 3 to 5 years after graduation). The teaching facilities and laboratories are good with modern equipment and appropriate student access. The student fee mechanism for funding these laboratories is seen as strong. A possible shortcoming is relatively weak participation of regular (tenured and tenure-track) faculty in the capstone design experience. The assessment process proposed for capstone design is very comprehensive but may be strengthened by the addition of a faculty mentoring metric (e.g. fraction of projects mentored by regular faculty) to the assessment and perhaps including a stronger consideration of capstone design mentorship in the annual faculty review process.

Observations specific to the undergraduate Computer Engineering program:

The CE program is perceived by some students as weaker than the EE program, in part due to the smaller number of core faculty (roughly 10 vs. 24). In the current climate of limited resources and a push for a broader perspective for students, there may be opportunities for increased collaboration with Computer Science (CS). In particular, both CE and CS should explore the possible benefits of additional course cross-listings, teaching across department boundaries and making use of courses from the other department for their programs. University-level policy changes to remove the current disincentives for cross-listing and teaching across department boundaries should be considered. Such changes would also assist the department and university in their quest for greater interdisciplinarity.

A2. Graduate programs

The UNM Graduate Office is not very visible and seems to have few institution-wide programs for graduate students regarding such issues as ethical behavior, research compliance, cultural awareness, teaching methods, and pre-faculty training. The administration of visa, immigration and I-20 processing by the international students office leads to some frustration (as is typical at many peer institutions). The ECE graduate students appear satisfied with their professional development at the department and research group level for such things as support for conference travel and teaching experiences. They also appreciate the mentoring and guidance by the faculty for career advice. The ECE stipends appear to be somewhat lower than peer institutions but this does not seem to cause competitiveness or student satisfaction issues. There appears to be some dissatisfaction among students with the distance education delivery of courses. Some review of alternative delivery technology and closer interaction with the instructors may be warranted. The time-to-degree for both MS and Ph.D. programs appears consistent with peers. The Ph.D. Qualifying exam is rigorous in terms of its content but there is some concern among students about the consistency and predictability of the content in some topic areas. In particular, there appear to be some issues when the faculty member writing the exam is not the instructor who delivered the course taken by the student.

A3. Department administration

There is near universal support for the leadership skill and approach of the department chair. The department administration takes pride in its academic and research programs and promotes them vigorously. The department staff appears to be overall effective and generally satisfied. Staff members specifically noted the willingness of the department administration to encourage and financially support their professional development through external training and interaction with their peers. Some attention to research proposal preparation as well as post-award research administration may be needed. The department makes appropriate leveraging of the expertise of local experts (e.g. from national labs) to augment its teaching and research missions. The department's focus on K-12 outreach and diversity efforts is especially laudable and the school should find a way to recognize and reward this activity.

A4. University level observations not included above

Proposal preparation and post-award research administration appears to be very uneven. Some areas experience extreme difficulties (faculty do everything themselves) and other areas have well trained and responsive staff. Particularly troublesome are events such as the entire university proposal processing operation occasionally closing for multiple consecutive days (such an announcement occurred during our visit). This is not appropriate for a research university. The development activity at the university appears relatively unsophisticated given the rich history of the institution. Engagement of the alumni, advisory boards, foundations and philanthropic organizations should be a regular part of the university culture. Physical building infrastructure maintenance, renovation and upgrades appear to be inconsistently funded. ABET will likely ask questions about infrastructure funding mechanisms. University-wide mechanisms for recording student credit hours appear to be a disincentive for teaching across department boundaries and may discourage multidisciplinary teaching activity. Inconsistent overhead-return policies may discourage multidisciplinary research activities.

Section V Responses to ECE-specific questions

B1. How should we adapt to the increasing demands of interdisciplinary programs?

1. These interdisciplinary programs would benefit from more flexibility in the curriculum and sharing courses. Accounting for student credit hours by the department of the instructor may encourage more teaching across department boundaries and in interdisciplinary programs. Reducing the paperwork required for offering cross-listed courses may also encourage more to take place. Prioritizing discretionary funding for multidisciplinary programs and research may encourage more faculty members to participate. Streamlining proposal processing and increasing the consistency of overhead return policies among units may encourage more interdisciplinary activity. Implementing a more generous return policy for interdisciplinary activity may also encourage participation but may be in conflict with the goal of a consistent policy among units.

B2. Under the current funding constraints, how can we come up with creative and sustainable plans for faculty hiring and graduate students recruiting?

2. Providing a mechanism for departments to accumulate unfilled position funds and surpluses locally would allow more flexibility in responding to funding fluctuations. Hiring groups of faculty in a single area or in related areas may allow for significant leveraging of start-up equipment funds. Prioritizing and concentrating research investment areas will make it easier to identify group hiring opportunities. Leveraging local opportunities such as the national labs may help identify unique niches for the investment areas. Funds to bring prospective graduate students to campus can be especially effective in recruiting top candidates.

B3. How might we modify our undergraduate programs to respond to increasing demands for breadth of knowledge in new areas? And how can we reward faculty members who are involved in these new areas like IP generation and tech transfer?

3. Introducing flexibility into the curriculum is a clear approach. In ECE the first steps are under way to reduce required courses and increase elective opportunities. Developing entrepreneurial coursework, seminars, internship opportunities are also worthy of consideration. Financial incentives for faculty to participate personally in tech transfer are in place through royalty sharing. Streamlining the invention disclosure and IP protection processing to make them easier for faculty to pursue may help broaden participation.

B4. What initiatives would you recommend, either at the school of university level, that could help us increased the number of students studying engineering and UNM?

4. ECE is already very active in outreach to K-12 students and teachers. Other activities to consider include: summer boot camps for students, teacher training, First Robotics, NM Supercomputer Challenge, Infinity Project, participation in the dual credit high-school requirement, and articulation of more engineering courses with the community colleges.

B5. What initiatives would you recommend, either at the school or university level, to reduce bureaucracy and focus the faculty's efforts on securing funding and doing research?

5. As mentioned previously it is critical to streamline proposal processing and to provide better post-award research administration. This may be done at any or all of the university, school, department or center levels. A specific suggestion is to approach the research administration groups at institutions with a strong track-record in this area (e.g. Georgia Tech and Stanford) to compare best practices.

B6. What concrete steps would you recommend to help us to improve our program rankings?

6. Faculty recognition is the strongest correlation with program rankings. While faculty size is also strongly correlated with rankings it is not always the case that growth in faculty size by itself leads to increased recognition and improvement in rankings. Other approaches require careful strategic planning in order to maximize the impact of the investment. Recruiting high-profile faculty (IEEE fellows and NAE members) to fill faculty vacancies can be especially effective. This often requires the use of endowed professorships and identifying donors for this must be started very early in the planning process. Another effective approach is to identify niches where UNM can build internationally recognized top programs. Leveraging the state's unique natural, human and infrastructure resources may be a starting point.

Section VI Recommendations and Conclusions

The general observations (Section IV) and responses to the ECE-specific questions (Section V) contain detailed recommendations. Here we provide a brief summary of these recommendations. Note that these recommendations represent the views of a

committee which does not have a detailed knowledge of the institution and its internal processes. Thus further consideration of the appropriateness of these recommendations should be considered by the department, school and university.

A. Department focused recommendations:
A1. Encourage more tenured and tenure-track ECE faculty participation in formal mentorship of senior design.

A2. Reduce the anxiety of ECE Ph.D. students with respect to the qualifying exam by providing a more consistent coverage of topic material on the exam and in the relevant courses.

A3. Work with the Vice President for Research to improve administrative research support for ECE faculty for both pre-award (proposals and budgets) and post-award (accounting) activity. Successful structures such as those of centers at UNM may serve as models for this support.

A3. Improve the ECE support for both pre-award (proposals and budgets) and post-award (accounting) research activity of the faculty.

A4. Consider a faculty recruiting strategy that leverages local strengths (e.g. national labs), focuses on a few targeted interdisciplinary areas and pursues recruits in groups so that start-up equipment and facilities can be shared.

B. School of Engineering focused recommendations:
B1. Examine the current delivery method of on-line programs and consider upgrading the experience.

B2. Provide a reward mechanism for departments that excel in K-12 outreach and marketing of engineering to the public as well as peers.

B3. Consider a development approach that more fully integrates the engagement of the alumni, advisory boards, foundations and philanthropic organizations as a regular part of the faculty culture. Begin to raise funds now for future endowed faculty positions.

B4. As recommended in A3, consider a faculty recruiting strategy that leverages local strengths (e.g. national labs), focuses on a few targeted interdisciplinary areas and pursues recruits in groups so that start-up equipment and facilities can be shared.

C. University level recommendations:
C1. Remove the current university disincentives to interdisciplinary teaching by i) awarding student credit hour teaching recognition to the department of the instructor rather than the degree program of the students and ii) reducing the paperwork burden for cross-listing of courses.

C2. Institute university-wide programs through the Graduate Office in such topics as ethical behavior, research compliance, cultural awareness, teaching methods, and pre-faculty training.

C3. Consider a refocusing of resources to support research activity. This should include a more professional approach to pre-award and post-award support for faculty as well as incentives for increased research productivity. If interdisciplinarity is to be a major thrust, consider making this a pre-requisite for any new investments and rewards.

C4. As recommended in A3 and B4, consider a faculty recruiting strategy that leverages local strengths (e.g. national labs), focuses on a few targeted interdisciplinary areas and pursues recruits in groups so that start-up equipment and facilities can be shared.

The committee believes that the ECE department and its programs have flourished under the leadership of the current chair as evidenced by the growth in student size, faculty research activity and improving national reputation. The department is strong relative to its current peer group (top 50-75 ECE programs) and has realistic aspirations for achieving many of the metrics of the top 25-50 peer group, especially in its research and graduate programs. The committee believes that examining the appropriateness of each of our recommendations has value, whether or not the recommendations are ultimately implemented. We look forward to the institution's response to our report.

Appendix 1.

ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT SITE VISIT ITINERARY
February 23-25, 2009

Day One: Monday, February 23, 2009

Time	Activity	Who is responsible	Location
07:15 – 07:30 a.m.	Review team picked up at hotel, driven to campus	Chaouki Abdallah	
08:00 – 08:30 a.m.	Orientation breakfast with: Review Team Wynn Goering, Vice Provost for Academic Affairs Nancy Middlebrook, Accreditation Director Bessie Gallegos, APR Specialist Chaouki Abdallah, Chair Greg Heileman, Assoc. Chair, Dir.-UG Progr. Wennie Shu , Assoc. Chair, Dir.-Grad. Progr. Mimi Stephens, Department Administrator	Bessie Gallegos, APR Specialist	Electrical and Computer Engineering, ECE Bldg., Room 118
08:30 – 09:45 a.m.	Team planning and orientation: Review Team, Chaouki Abdallah, Greg Heileman, Wennie Shu, Mimi Stephens, Bessie Gallegos	Bessie Gallegos, APR Specialist	ECE Bldg., Room 118
09:45 – 10:00 a.m.	Break		
10:00 – 11:00 a.m.	Meeting with SOE Dean, Joe Cecchi	Bessie Gallegos, APR Specialist	School of Engineering Dean's Office, CEC 3071
11:00 – 12:00 p.m.	ECE Lab Tour Classroom Visits: ECE 371, Materials & Devices, G. Balakrishnan, ECE 514, Nonlinear & Adapt. Cont., C. Abdallah, ECE 520, VLSI Design, P. Zarkesh-Ha,	ECE Host: Christos Christodoulou	ECE Bldg., Basement Room 310 (1100-1150) Room 210 (1130-1245) Room 132 (1130-1245)
12:00 – 02:00 p.m.	Lunch off campus	ECE Hosts: Greg Heileman & Olga Lavrova	Yanni's Greek Restaurant
02:15 – 03:15 p.m.	ECE UG & Graduate Student Open Forum	GSA & IEEE Student Chapter	ECE Bldg., Room 118
03:30 – 03:45 p.m.	Break		
04:00 – 05:00 p.m.	Wine & Cheese Reception at Faculty Club for ECE Faculty	ECE Host: Sanjay Krishna	UNM Faculty Club
05:15 p.m.	Return to Hotel	Chaouki/Greg/Wennie	
06:00 p.m.	Working dinner @ Albuquerque Grand Airport Hotel or at an Albuquerque restaurant – Review Team	Review Team	

Day Two: Tuesday, February 24, 2009

Time	Activity	Who is responsible	Location
07:30 – 08:30 a. m.	Breakfast at hotel	Review Team	
08:30 a.m.	Pick up at hotel; deliver to Scholes Hall	Chaouki/Greg/Wennie	Scholes Hall, Room 246
09:00 – 09:30 a.m.	Meeting with Vice Provost for Academic Affairs, Wynn Goering	Bessie Gallegos, APR Specialist	Scholes Hall, Room 246
09:30 - 10:00 a.m.	Meetings with University Administrators: V.P. for Research and Econ. Dev., Julia Fulghum Acting Dean of Grad. Studies & Assoc. Dean of SOE, Chuck Fleddermann	Bessie Gallegos, APR Specialist	Scholes Hall, Room 246
10:00 – 10:15 a.m.	BREAK		
Confidential Meetings 10:15 – 11:15 a.m.	Meetings requested by ECE Faculty, students or community members	contact Bessie Gallegos at 7-3330 to schedule meeting	Scholes Hall, Room 246
11:15 – 11:30 a.m.	Return to ECE		
11:30 – 01:00 p.m.	Lunch off campus	ECE Host: Plusquellic/Shu	
01:15 – 03:15 p.m.	Individual ECE Faculty meetings (15 min. each): Caudell (1:15-1:30), Shu (1:30-2:00, Grad.Progr.), Sen (2:00-2:15), Abdallah (2:15-2:30), Forrest (2:30-3:00, Chair-Computer Science), Santhanam (3:00-3:15), Mostofi (3:15-3:30)	[contact Mimi to schedule meeting]	ECE Bldg, Room 118
03:15 – 03:30 p.m.	BREAK		
03:30 – 04:00 p.m.	ECE Staff	ECE Host: Stephens	
04:00 – 04:30 p.m.	Individual ECE Faculty Meetings (15 min. each): Dorato (4:00-4:15), Krishna (4:15-4:30)		
04:30 – 05:00 p.m.	CHTM Tour of Facilities	CHTM Host: Brueck/Krishna	CHTM
05:15 p.m.	Return to hotel	Chaouki/Greg/Wennie	
06:00 p.m.	Working dinner @ Albuquerque Grand Airport Hotel or at an Albuquerque restaurant Review Team Members	Review Team	

Day Three: Wednesday, February 25, 2009

Time	Activity	Who is responsible	Location
07:30 – 08:15 a.m.	Breakfast at Hotel	Review Team	
08:30 – 09:00 a.m.	Meeting with Suzanne Ortega, Provost & Exec. V.P. for Academic Affairs	Bessie Gallegos, APR Specialist	Scholes Hall, Room 240
09:00 – 11:00 a.m.	Team meeting to draft report Breaks as needed Coffee & Cold Beverages provided	Review Team	ECE Bldg., Room 118
11:00 – 11:15 a.m.	Review Teams walks to Scholes Hall		Scholes Hall, Roberts
11:30 – 12:30 p.m.	Exit meeting & lunch (provided) attended by: Review Team Suzanne Ortega, Provost & Exec. V.P. for Academic Affairs Richard Holder, Deputy Provost Wynn Goering, Vice Provost for Academic Affairs Julia Fulghum, V.P. for Research & Econ. Dev. Michael Dougher, Assoc.V.P. for Res. & Econ. Dev. Joe Cecchi, Dean, School of Engineering Chuck Fleddermann, SOE Assoc. Dean-Academic Affairs; Acting Dean of Graduate Studies Kevin Malloy, SOE Assoc. Dean for Research Chaouki Abdallah, ECE Chair Greg Heileman, ECE Assoc. Chair & Dir.-UG Progr. Wennie Shu, ECE Assoc. Chair & Dir.-Grad.Progr. Mimi Stephens, Department Administrator Roli Varma, Faculty Senate Graduate Committee Andrew Burgess, Faculty Senate UG Committee Kathleen Keating, Faculty Senate Curricula Comm. Nancy Middlebrook, UNM Accreditation Director Tom Root, Outcomes Assessment Planning Mgr. Bessie Gallegos, APR Specialist	Bessie Gallegos, APR Specialist	Scholes Hall, Roberts Room
12:30 - 01:30 p.m.	Transport Reviewers to Hotel or Airport	Chaouki/Greg/Wennie	