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# MET Graduate Survey Results

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## ABSTRACT

In February 1997, we undertook a survey of the MET graduates from the Northeastern University School of Engineering Technology. The sample included both Bachelors and Associates degree graduates, their employers, as well as some of our current evening students for comparison. A total of 155 responses were received and analyzed. In this paper, we present the results of this analysis. These results include information on what our graduates are doing, what they find most important from their education, their pursuits of further education, their professional associations (including registration), and general implications these results have upon the MET curriculum.

## INTRODUCTION

In February 1997, we undertook a survey of the MET graduates from The School of Engineering Technology at Northeastern University. The main goal in this survey was to learn what skills our alumni found most and least important in the work place. Particular interests were the balance between technical knowledge and skills versus the process skills including problem solving and communications. Additionally, we wanted to probe two specific areas within the curriculum: graphics and computer usage.

The survey instrument is shown in the Appendix to this paper. Before creating this survey instrument a literature search was conducted. From this search, a number of previous survey instruments were found and used as examples in creating this instrument. Some of the more useful examples include those reported by Stanley[1], Britton[2] and Rockland[3]. The core of this survey is the second page: a series of 33 questions asking the responder to rate each area on a scale of one to five in terms of importance on the job and secondly in terms of how well their education prepared them in each of these areas. In addition, the respondents were asked to respond to ten specific questions.

This survey instrument was sent to all our alumni graduating between 1990 and 1996 (approximately 1200 alumni in the combined areas of Mechanical Engineering Technology, Electrical Engineering Technology, and Computer Technology). These alumni included recipients of both Bachelor and Associate degrees. Thirteen percent of the alumni responded to the survey. Only responses from MET alumni are reported in this paper while a second paper presents the results from the Electrical Engineering Technology alumni. The alumni were also asked to forward a second survey instrument to their supervisor. Only fourteen responses to this second survey instrument were received from supervisors. Finally, a group of evening students were asked to complete a similar survey. The evening students are adult students who hold full

time jobs. Hence, they are familiar with the workplace and know why they are going to school and what they hope the degree will do for their career. We wanted to learn how similar their responses compared to the alumni responses and if current evening students could provide a proxy for our alumni in future surveys. A total of 155 responses were received from MET students, including 74 current students, 67 alumni, and 14 employers.

## RESULTS

To characterize the respondents to the survey, their job titles are shown in Table 1.

**Table 1: Current Job Titles of Respondents**

| **Title** | **Alumni** (Bachelors) (55) | **Alumni** (Associates) (7) | **Current** (65) |
|---|---|---|---|
| Engineer | 32 | 2 | 20 |
| Manager | 11 | | 5 |
| Technician | 4 | 1 | 19 |
| Designer | 2 | 2 | 2 |
| Student | | | 14 |
| Other | 6 | 2 | 5 |

The first column of this table shows the job title of the respondent. The other columns show the number of respondents in each category that held that job title. The number at the top of the column (in parentheses) shows the number of respondents in each category. Some respondents did not answer all questions, so totals on this and subsequent tables do not add up to the total number of responses received (155). *Seventy five percent* of our graduates with a bachelors degree are functioning as either an engineer or manager (43 out of 55) and only ten percent as technicians or designers (6 out of 55). Thus, it appears that our graduates are accepted in the workplace as engineers. This is an area or concern for technology educators who are concerned that the MET degree is not accepted in the workplace. In contrast to this observation, fifty percent of our associate degree recipients and forty percent of our current students (who are not full time students) are working as either technicians or designers. Thus it appears through this and other anecdotal evidence that the bachelors degree is the “ticket” to the title of engineer or manager. Though one must be careful in drawing conclusions from such a small sample. It is also interesting that nearly fifty percent of our current part time students also have engineer or manager in their title. Thus one concludes from this survey that they are continuing in school to preserve this position or to prepare themselves for further promotions.

The industrial sector employing the respondents is shown in Table 2. This table follows the same format as Table 1. The largest industries employing our students are design/development, manufacturing, and computer/electronics/controls.

**Table 2: Industries Employing the Survey Respondents**

| Industry | Alumni (Bachelors) (56) | Alumni (Associates) (7) | Current (68) | Total (131) |
|---|---|---|---|---|
| Development/Design | 8 | 3 | 14 | 25 |
| Manufacturing | 10 | | 14 | 24 |
| Computer/Electronics/Controls | 11 | 1 | 5 | 17 |
| Construction | 8 | | 2 | 10 |
| Utility | 2 | | 3 | 5 |
| Thermal Systems | 4 | | | 4 |
| Self Employed | 2 | 2 | | 4 |
| Other | | | 6 | 6 |
| Student | | | 13 | 13 |
| Unknown | 11 | 1 | 11 | 23 |

In furthering their education, 13 out of 59 of our bachelors degree alumni (22%) are pursuing an advanced degree. The respondents were also asked about their professional affiliations. Ten of our bachelors alumni are members of ASME, five members of ASHRAE, four of SAE, and three are members of ASQC. Additionally, respondents were members of twenty two other professional organizations with one or two members of each. Ten of our recent alumni (17%) have passed the EIT exam and two (3%) have obtained the Professional Engineer Registration. Unfortunately, we did not ask the respondents how many had attempted the exam and not passed it. This is a high rate of PE registrations considering that it is a survey of alumni less than seven years from graduation. This rate of passing the EIT exam is lower than the twenty eight percent found by Old Dominion University in their 1993 survey[1]. Their study, however, included alumni graduating up to 19 years prior to the study. Thus, it appears that our Bachelor degree alumni are accepted into the professional community, another concern with MET educators. Conversely only two of our associate degree students were members of any professional organization and none of the current students were members of any professional organization.

As stated in the introduction, the core of this survey was the quantitative evaluation of the thirty three specific questions on the second page of the survey. The respondents were asked to rate on a scale of one to five how important each of the categories was to their job, with five being the most important. The average response for all questions was 3.5 with a standard deviation of 1.13. Responses were averaged and the standard deviation calculated separately for each question and each category of recipient.

The first question is what skills the respondents consider most important to their job. The highest numerical responses (most important) are presented in descending order in Table 3.

**Table 3: Most Important Skills**

| Skill | Alumni (Bachelors) (59) | Alumni (Associates) (8) | Employer (14) | Current (73) | Total (154) |
|---|---|---|---|---|---|
| Problem Solving | 4.57 | 4.63 | 4.54 | 4.39 | 4.49 |
| Teamwork | 4.51 | 4.88 | 4.46 | 4.25 | 4.40 |
| Professional Ethics | 4.51 | 4.50 | 4.54 | 4.17 | 4.35 |
| Accomplishing Tasks | 4.49 | 4.43 | 4.38 | 4.33 | 4.40 |
| Oral Communications | 4.42 | 4.75 | 4.46 | 4.11 | 4.29 |
| Visualizing Objects | 4.31 | 4.50 | 3.85 | 4.17 | 4.21 |
| Design Process | 4.29 | | | 4.25 | 4.16 |
| Writing | 4.27 | 4.00 | 4.43 | 4.11 | 4.19 |
| Managing People | 4.05 | 4.00 | 4.00 | 3.95 | 4.00 |
| Sketching | 4.05 | 3.63 | | 3.78 | 3.87 |
| Using CAD Systems | 4.03 | 3.75 | 3.46 | 4.32 | 4.10 |
| Safety | 3.91 | | 3.83 | 3.75 | 3.81 |
| Materials | 3.88 | 4.13 | 3.92 | 4.18 | 4.04 |
| Use of PC Tools | 3.79 | | 3.85 | 3.98 | 3.86 |
| Manufacturing Processes | 3.76 | 4.29 | 4.00 | 3.93 | 3.89 |
| Mechanics | | 3.88 | | 4.13 | 3.84 |
| Using Advanced CAD Systems Tools | | | | 4.00 | 3.71 |

This table is ordered by the response of Bachelor degree alumni in descending order. However, responses are similar between all groups considering the uncertainty of the averages. The areas of greatest importance are *problem solving, teamwork, professional ethics, accomplishing tasks within the organization, and oral communications*. The highest technical items are visualizing objects and the design process. Scores are statistically significant ($2\sigma$) at a difference of 0.3. Thus these skills, plus writing, are all at a statistically similar level of importance. The rest of the items on this list are all in a statistically lower level of importance. Notice the highest technical topic is Safety followed closely by Materials, all at a statistically lower level than the first set of skills. Thus, functioning in the workplace is more important than any technical skills. The results are similar between the other respondent categories. Numbers omitted from this table means that the response was not high enough to be included in one of the most important categories.

Results from this survey were similar to results from other surveys reported in the literature. For example, the New Jersey Institute of Technology survey found that their Principles of Management was the most useful course and writing was the most important skill on the job[3]. The Ohio State University study found Communication and Problem Solving skills were rated higher than any technical skills[4]. Also the OSU study found that the highest ranked technical skills were in the computer and graphics area[2]. However, our results put a higher emphasis upon CAD knowledge and a lower emphasis upon computer programming than the OSU study. This change may simply reflect the changes in the workplace since their study was undertaken in 1992. In the rating of technical skills in the OSU study, mechanics, statistics, materials. and economics had the highest ratings[4]. Only materials shares a similar high rating in this study. This could reflect the different industries that the alumni work in when the Boston area is compared to the Ohio area. At Northeastern University we also asked our College of Engineering industrial advisory board to provide us their perspective of the workplace of the 21st century and what skills our graduates need to work in that environment. Again, responses to that question emphasized communications and problem solving skills[5].

The second question is what skills the respondents consider least important to their job. The lowest numerical responses (least important) are presented in ascending order in Table 4.

**Table 4: Least Important Skills**

| Skill | Alumni (Bachelors) (59) | Alumni (Associates) (8) | Employer (14) | Current (73) | Total (154) |
|---|---|---|---|---|---|
| Visual Basic Programming | 1.82 | 2.25 | 2.15 | 2.70 | 2.24 |
| C Programming | 1.89 | 2.13 | 2.29 | 2.74 | 2.30 |
| Differential Equations | 1.91 | 2.13 | 2.00 | 2.69 | 2.28 |
| Unix | 2.00 | | 2.21 | 2.79 | 2.44 |
| Calculus | 2.20 | | 2.00 | | 2.65 |
| Digital Circuits | 2.25 | 1.86 | 2.25 | 2.64 | 2.39 |
| Building Systems | | 2.43 | | | 3.15 |
| Basic Electronics | | 2.43 | | | 2.98 |

Traditional computer programming and math (calculus and differential equations) appear high on this list, and hence low in importance in the workplace. Thus our alumni do not find these skills that we taught them important on the job. This finding is not as strong with the current students where we force them to use both of these skills in their courses. Thus the university curriculum is influencing these results for this group.

Previous studies have also found similar results. In the Ohio State University study differential equations were found to be the least important technical skill in the survey instrument[4]. Similar

results were also obtained by the New Jersey Institute of Technology survey. This survey singled out mathematical courses as being the least helpful in the curriculum[3].

It is also useful to examine the standard deviations of the responses to the thirty three questions on the back of the survey. Table 5 shows the responses with the lowest standard deviation (less than 1.0) ranked in ascending order by the responses of the Bachelors Degree respondents. The low standard deviation is an indication of consensus between respondents. Hence all respondents agree with the average response. This table shows that the areas rated as most important to the respondents career are agreed to by all respondents. The uniform consensus, however, is not as strong for the least important skills.

**Table 5: Smallest Standard Deviations**

| Skill | Alumni (Bachelors) (59) | Alumni (Associates) (8) | Employer (14) | Current (73) | Total (154) |
|---|---|---|---|---|---|
| Problem Solving | 0.70 | 0.52 | 0.66 | 0.76 | 0.70 |
| Oral Communications | 0.72 | 0.46 | 0.66 | 0.99 | 0.85 |
| Writing | 0.76 | | 0.65 | 0.81 | 0.79 |
| Teamwork | 0.82 | 0.35 | 0.52 | 0.84 | 0.80 |
| Professional Ethics | 0.84 | 0.53 | 0.52 | | 0.91 |
| Accomplishing Tasks | 0.88 | 0.53 | 0.77 | 0.79 | 0.81 |
| Design Process | 0.95 | | 0.96 | 0.94 | |
| Visualizing Objects | 0.97 | 0.76 | | | |
| Materials | | 0.64 | | 0.85 | |
| Manufacturing Processes | | 0.76 | | 0.91 | |
| Mechanics | | 0.64 | | 0.92 | |
| Electrical Power Systems | | 0.76 | | | |
| Calculus | | 0.92 | 0.85 | | |
| Differential Equations | | 0.99 | | | |

To mirror Table 5, Table 6 shows the responses with the largest standard Deviation. This indicates a lack of consensus in the average between the respondents. Hence only some respondents find the particular skill unimportant. Computer Tools and Computer Programming are high on this list. Thus these skills are important to some respondents but not to others.

**Table 6: Responses with the Largest Standard Deviation**

| Skill | Alumni (Bachelors) (59) | Alumni (Associates) (8) | Employer (14) | Current (73) | Total (154) |
|---|---|---|---|---|---|
| Unix | 1.43 | 1.53 | 1.31 | 1.23 | 1.41 |
| Advanced CAD Tools | 1.43 | 1.69 | | | 1.36 |
| Workstations | 1.47 | 1.51 | | | 1.35 |
| Building Systems | 1.53 | | 1.31 | | 1.36 |
| CAD Systems | | 1.58 | | | 1.28 |
| Visual Basic Programming | | 1.58 | | 1.28 | 1.26 |
| C Programming | | 1.64 | | | 1.3 |
| PC Tools | | 1.69 | 1.34 | | |
| Design Process | | 1.75 | | | |
| Drawing Tools | | 1.77 | | | 1.30 |
| Electrical Power Systems | | | 1.38 | | |
| Safety | | | | 1.27 | 1.28 |

## CURRICULUM IMPLICATIONS

The point of doing any survey, such as this, is to use the results to determine what is important and should be emphasized within the curriculum and what should receive less emphasis. This section of the paper will discuss the curriculum implications of this survey. Obviously, this is not the sole input to any curriculum revisions, but merely one of many inputs in determining what should be taught within the Mechanical Engineering Technology curriculum.

The overwhelming conclusion from this survey, is that the curriculum needs to emphasize process skills rather than technical learning. These skills include problem solving, teamwork, and communications (both oral and written). One way to do this is to incorporate design projects within the technical classes: A group design project, with a final written report, requires the use (and hence learning) of all of these skills. A second opportunity to emphasize these skills is in laboratory reports. It is easy to fall into the mode of providing detailed directions for each laboratory experiment and to require individual written reports from each student. However, by providing only superficial directions and goals for the experiment, the students must develop their problem solving skills (how to do the experiment). Secondly, by requiring group reports, the students will develop their teamwork skills. On the basis of this survey, the authors have incorporated design projects into all their courses and required laboratory reports to be completed with a partner. Results have been very good and the students appreciate the changes.

The second conclusion from this survey is that the computer skills we teach the students need to be reevaluated. Computer literacy with a personal computer using applications packages is high in the required skills list. However, the traditional computer programming skills were assigned a low priority. Thus the emphasis in teaching computer literacy in MET should shift away from

the traditional languages (C++, Visual Basic) and more toward application packages (Excel, Word, CAD, MathCad) available on a Personal Computer. Languages and alternative computer platforms (Workstations with UNIX) should be taught within elective courses. This is because some respondents found these skills important and should hence have the opportunity to learn them within the curriculum.

The MET curriculum also needs to emphasize the use of graphical skills. Visualization, Sketching, Drawing, CAD and Advanced CAD all scored high on the important skills list from both this and prior surveys. However, the traditional MET curriculum teaches the traditional graphics in the freshman year and makes little use of these skills in the upper level courses. First application of graphical skills is frequently in the capstone design course during the senior year. Additionally, advanced CAD tools, including solid modeling, are only offered as an elective within the traditional curriculum. We need to strengthen our freshman graphics program and use graphical tools to help teach the upper level courses using Advanced CAD tools. This approach is currently being pursued at Northeastern University and is the topic of another paper at this meeting.

Mathematics was singled out in this survey, as well as several others to be the least helpful course sequence in the curriculum[3,4]. However math, as well as the basic sciences, are underpinnings of the technical education and must be included in the curriculum. However, we might be able to refocus our mathematical instruction to make it more beneficial to the students and useful to their careers. Possibly, by teaching more applications in the mathematics curriculum or moving more math topics into the technical course sequence, we can make the math more interesting and show the students how to use math to solve problems.

Also pointed out by this study is the need to strengthen certain technical areas that are traditionally given only passing mention. These include ethics and safety. These are two topics that are generally acknowledged as being important. However, they are frequently only taught as auxiliary material within other courses. For example, the study of employers of Stevens Institute of Technology engineering undergraduates found deficiencies in the ethical training of the graduates[6]. We need to consider dedicated courses in these topical areas.

## CONCLUSIONS

Contrary to what we hear in educational circles, I am pleased to say that our graduates are being accepted within the professional community. A large fraction of our graduates serve in engineering or managerial capacity and are members of professional organizations. Additionally, several have passed the EIT exam and achieved Professional Engineer Status.

The most important conclusion from this survey is that higher emphasis must be placed upon teaching process skills. These process skills include how to solve problems in teams and communicate with others. Thus our education must emphasize these processes skills in addition to teaching specific technical material.

The results of the survey were very consistent between the four different groups responding. General conclusions drawn from the groups of Bachelor degree alumni, Associate degree alumni, Employers, and our current evening students are all consistent. Thus, for convenience, current evening students can be used as a proxy for the larger population in future surveys.

## REFERENCES


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## WILLIAM E. COLE

Dr. Cole received his Bachelors of Mechanical Engineering Degree from Stevens Institute of Technology and his Doctor of Philosophy from the Pennsylvania State University. He has over twenty years of industrial experience developing industrial process equipment at The United Technologies Research Center and Thermo Electron Corp. Dr. Cole is now using this industrial experience to help educate the next generation of engineers.

## CHARLES W. P. FINN

Professor C.W.P. (Charlie) Finn, BSChE NU '67, Ph.D. MIT '71 has been the Director of the School of Engineering Technology at Northeastern University in Boston since 1995. His academic and industrial career spans 3 decades and 4 continents (Australia, Africa, Asia and North America). He has worked in the steel and industrial equipment industries and taught in both engineering and engineering technology programs prior to becoming an administrator. Since his earliest days as a COOP student at Northeastern University, Dr. Finn has practiced the educational philosophy of "Learn by doing". His experiences teaching mining and metallurgy students in the Australia outback reinforced this belief. A relative new comer to the field of Engineering Technology, he has "found his home" in a profession that suits his philosophy to a T.

# APPENDIX – SURVEY INSTRUMENT

February 20, 1997

As a recent graduate of the Engineering Technology Program at Northeastern University, we would like your opinion of the Engineering Technology Program and how well it prepared you for your current job. Results of this survey will be used to help us strengthen the program and direct it toward the jobs of our alumni. We hope that you will take a few minutes to complete this form and return it in the attached postage paid envelope. Additionally, there is a blue form attached. We would appreciate it if you give this form and the second postage paid envelope to your immediate supervisor so we may obtain his opinion on the quality of our program. Once again, thank you for your time and I appreciate your assistance in this survey.

Sincerely,

Charles Finn
Director, School of Engineering Technology

1. Your Current Job Title: _____

2. Your Current Employer: _____

3. Your Major at Northeastern University: CT EET MET AERO MFG
   Full Time Part Time

4. Do You Feel that the Engineering Technology Program prepared you adequately for your career? If no please explain. YES NO

5. What professional organizations do you belong to? _____

6. Are you licensed or certification in your professional field? EIT PE Other_____

7. Have you obtained or are you currently working on an advanced degree? NO YES

8. What Skill is most important in your current job? _____

9. A lack of preparation in what area has most limited your career? _____

(OVER)

Please circle the numbers that indicate how important each skill is to successful performance in our

alumni's current position and how well Northeastern University prepared him in each of these areas.

| | | Importance on Job | | | | | Preparation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | unimportant | | | | critical | inadequate | | | sup | erior |
| 20 | Basic Engineering Skills | | | | | | | | | | |
| a | Calculus | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| b | Differential Equations | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| c | Statistics | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| d | Mechanics | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| e | Materials | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| f | Thermodynamics/Fluid Dynamics | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| g | Building Systems | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| h | Basic Electronics | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| I | Electrical Power Systems | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| j | Digital Circuits | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| k | Engineering Economics | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| l | Safety | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| m | Manufacturing Processes | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| n | Laboratory Skills | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| o | Design | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 21 | Basic Graphics Skills | | | | | | | | | | |
| a | Sketching | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| b | Visualizing objects from 2D Drawings | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| c | Use of Drawing Tools | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| d | Use of CAD Systems | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| e | Use of Advanced CAD Analysis | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 22 | Computer Skills | | | | | | | | | | |
| a | UNIX knowledge | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| b | Knowledge of Workstations | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| c | Programming in C | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| d | Programming in Visual Basic | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| e | Use of PC tools | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 23 | Communication and Problem Solving Skills | | | | | | | | | | |
| a | Writing Skills | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| b | Oral Skills | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| c | Problem Solving | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| d | Library Research Skills | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| e | Teamwork | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| f | Professional Ethics | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| g | Managing People | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| h | Accomplishing Tasks within the Organization | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 24 | Other ( ) | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |

25 What one or two Engineering Technology Courses were most helpful in advancing your career?

26 what one or two Engineering Technology Courses were least helpful in advancing your career?

27 If you had the opportunity to recommend this program to a fellow worker, would you recommend it positively?
YES NO