STUDENT LEARNING ASSESSMENT IN ENGINEERING TECHNOLOGY PROGRAMS WITH A "GRADUATION EXAM"

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Abstract

The Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET) is now incorporating student learning assessment criteria for engineering technology degree program accreditation. The Department of Mechanical Engineering Technology at IUPUI has determined that a senior level "graduation exam" similar to the Fundamentals of Engineering (FE) examination will be the optimal student outcomes assessment tool for its Mechanical Engineering Technology (MET) and Computer Integrated Manufacturing Technology (CIMT) degree programs.

This paper reports on the format of the graduation examination along with faculty experiences and insights of using a graduation examination as one of the assessment tools in an engineering technology program. Included in the discussion is how the graduation examination results are being used for course improvement and enhancement activities. The paper also includes a statistical analysis of the examination results in terms of correlation with overall grade point averages and time to degree completion.

Background

The Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET) recently revised the accreditation requirements for engineering technology programs[1]. The revised requirements are identified as Engineering Technology Criteria 2000 (ET2K). The ET2K criteria will continue the present policy of mandating the development and implementation of a continuous improvement plan. The ET2K criterion has added the requirement of "student outcomes assessment". Each institution is left to determine the methods that it uses to demonstrate achievements for each of its programs. The Associate of Science and Bachelor of Science degree programs in Mechanical Engineering Technology (MET) and Computer Integrated Manufacturing Technology (CIMT) were reaccredited by TAC/ABET under the pre-ET2K criteria in 2000 for the maximum term of six years.

Fortunately, the Department of Mechanical Engineering Technology has already been developing student outcomes assessment methodologies under the guidance of a school Assessment Committee led by Professor Charlie Yokomoto and IUPUI Program Review and

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Assessment Committee (PRAC). The initial step in developing a new continuous improvement plan for the MET and CIMT degree programs were to develop a student learning outcomes assessment plan based on the IUPUI Principles of Undergraduate Learning. This development of the student learning outcomes assessment plan followed a logical sequence[2]:

1. Identify the required courses than included the material identified in each specific measurable outcome.
2. Determine the courses where each specific measurable outcome will be assessed.
3. Determine the artifact or evidence, which will be collected and evaluated for student learning. The artifact can include any type of student work including tests, quizzes, homework, laboratory reports, term projects, oral reports, term papers or design projects.
4. Determine the evaluation method to be employed with the artifact or evidence.
5. Establish the expected level of performance.

Appendix I illustrates the evolving student learning outcomes assessment plan developed for the MET degree program at IUPUI.

The Department of Mechanical Engineering Technology determined that a senior level "graduation exam" similar to the Fundamentals of Engineering (FE) examination would be the optimal student outcomes assessment tool for several learning objectives in the MET and CIMT degree programs. The major impetus for the development of the exam was that, unlike engineering students in ABET accredited programs, engineering technology students are not permitted to take the FE exam during their senior year in the state of Indiana. Additionally, while the FE exam does cover a wide range of topics, it lacks questions in several of the required subject areas of the CIMT and MET programs, thereby making it limited as an assessment tool.

These graduation exams have been incorporated in the capstone, senior design project course required in each program. MET students take MET 414, Senior Design Projects and CIMT students take CIMT 481, Integration of Manufacturing Systems in the 8th semester in their respective plans of study. The exam represents 10% of the student's grade for these courses. It was decided by the department's faculty that to insure that students take the exam seriously, it must be made a component of the grade for the course.

The graduation exam will be only one component of the student outcomes assessment methodology in each program. The department will utilize student work such as examinations and laboratory reports to assess outcomes throughout each program. These assessment instruments will be evaluated using various scoring methodologies[3].

Fundamentals of Engineering Examination

Department faculty made the decision to develop a graduation examination that emulates the Fundamentals of Engineering (FE) examination. The National Council of Examiners for Engineering and Surveying (NCEES) manages the Fundamentals of Engineering (FE) and Principles and Practice of Engineering (PE) examinations[4]. These examinations are used for Professional Engineering registration process with the eight hour FE examination taken during the last semester of an engineering curriculum[5]. The eight-hour PE examination is taken after four years of documented employment in engineering.

In addition to being a component of the profession registration process, NCEES is working with academia to encourage the use of the FE examination to help engineering programs satisfy the student outcomes assessment required by the new EAC/ABET Engineering Criteria 2000 (EC2000) that is similar to the ET2K criteria[6]. The format of the FE examination is a series of multiple-choice questions covering all aspects of engineering education including engineering science, mathematics, physics, chemistry and economics.

Assessment Tool Design

The graduation examinations for the Mechanical Engineering Technology (MET) and Computer Integrated Manufacturing Technology (CIMT) programs were developed jointly utilizing funds received via a Program Review and Assessment Committee (PRAC) grant[7] and a grant from the School of Engineering and Technology. The general philosophy of the examinations is to employ a methodology similar to the Fundamentals of Engineering (FE) examination. Multiple-choice questions are utilized to assess the level of student learning from each of the core courses from the plan of study. Core courses are those identified by the faculty as being essential to a student's success after graduation. To emphasis the importance of these core courses, the MET and CIMT plans of study require students to complete the courses with a grade of C- or higher. Student learning in general education courses such as mathematics, physics, chemistry, communications are not assessed with the graduation examination. The department will rely on the various general education departments developing the appropriate assessment tools for their courses.

Each graduation exam is 120 questions in length. The MET examination assesses student learning in 12 subject areas using 10 questions for each area. The subject areas and respective course numbers are listed in table 1 and a section of the MET examination is included in appendix II. The CIMT examination assesses student learning in 15 subject areas using 8 questions for each area. The subject areas and respective course numbers are listed in table 2 and a section of the CIMT examination is included in appendix III. Since the MET and CIMT degree programs utilize common courses, a total of 56 questions are common between the two examinations.

Table 1. MET Examination Subject Areas

1	CGT 110/MET 102	Engineering Graphics
2	IET 350	Engineering Economics
3	MET 105	Engineering Calculations and Data Presentation
4	MET 111	Applied Statics
5	MET 141/MET 344	Materials
6	MET 142/MET 242	Manufacturing Processes
7	MET 211	Applied Strength of Materials
8	MET 213	Dynamics
9	MET 214	Machine Elements
10	MET 220	Heat Power and Thermodynamics
11	MET 230	Fluid Power
12	MET 350	Fluid Dynamics

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Table 2. CIMT Examination Subject Areas

1	CGT 110/MET 102	Engineering Graphics
2	CIMT 224	Production Planning
3	CIMT 260	Robotics
4	CIMT 310	Facilities Layout
5	IET 150	Industrial Statistics
6	IET 300	Dimensional Metrology
7	IET 350	Engineering Economics
8	IET 454	Statistical Quality Control
9	MET 105	Engineering Calculations and Data Presentation
10	MET 141	Materials
11	MET 142/MET 242	Manufacturing Processes
12	MET 212	Engineering Mechanics
13	MET 230	Fluid Power
14	MET 240	Foundry Science
15	MET 271	Computer Controlled Machining

The questions were developed by the department faculty responsible for each course and generally consist of comprehensive final examination type questions. For examination management reasons, an average time of 2 minutes is allowed for the solution of each question. This is similar to the Fundamentals of Engineering examination. The two-minute time limit was taken into consideration by the faculty during question development. The questions are kept confidential and are reused each semester. Reusing questions will allow the smoothing of the results to filter semester-to-semester variation and will allow the department to determine if improvements are being made in terms of student learning.

Engineering formulae, tabulated data, conversion factors and mathematical constants are not supplied to the senior taking the examination. Therefore, the examinations are open book and notes. With a total of 4 hours available to complete the 120 questions or the average of 2 minutes per question, the department faculty feels that an open book and notes format does not detract from the examinations student learning assessment ability. The examination is scored by the total number of correct answers with no deduction for incorrect answers. Multiple responses to a single question are scored as an incorrect answer.

Evaluation of Results

The MET assessment tool was completed first and has been utilized for three semesters beginning fall 2001. The CIMT assessment tool was utilized for the first time during the fall 2003 semester. Both the MET and CIMT graduation examinations are given concurrently.

The Department of Mechanical Engineering Technology is fully evaluating the results of the examinations using several measures. Individual responses for each question are placed into an Excel® spreadsheet to allow sorting and analysis. Appendix IV shows an excerpt of the data for the MET seniors who took the examination as part of their capstone senior design course over three semesters. The faculty member responsible for each core course incorporated in the assessment tool is given the data including the responses as part of the feedback process.

Additionally, since the questions are reused and some are common between the MET and CIMT assessment tools, data is being accumulated by question and provided to the appropriate faculty for use in the continuous improvement process.

Examination Validation

Validation of the graduation examination as a student learning assessment tool is an important component of the evaluation process. Validation analysis to date has used the overall results of the examination rather than questions by subject area or individual questions. The overall adjusted averages for the MET examinations to date are as follows:

Fall Semester 2001.....................41.73%

Spring Semester 2002.....................55.02%

Fall Semester 2002.....................44.41%

Adjusted averages do not include questions that were omitted by a student and are employed primarily to mitigate the effect of students failing to complete all the examination questions. The significant differences in averages may be attributed to several factors. First, the number of students taking the exam at each sitting is relatively small resulting in a higher level of variability. Also, beginning with the second cohort, students were much better prepared for the examination since information about the use and format of this assessment tool spread quickly through the students in the MET department. Another factor may relate to the relative academic success of each group. Following are the average overall graduate point averages (GPA) for each group:

Fall Semester 2001.....................2.8710 GPA

Spring Semester 2002.....................3.4217 GPA

Fall Semester 2002.....................2.8959 GPA

Analysis shows that the assessment exam scores and GPA's do not have a high degree of correlation with an overall $R^2 = 0.3206$ for the three offerings of the exam. However, the trend line for the data does exhibit a positive slope. Chart 1 shows the relationship between a student's GPA and the MET graduation examination percentage score.

A final factor that has been considered when validating the examination is the time to degree completion of the participants. The Department of Mechanical Engineering Technology at IUPUI attracts a large percentage of non-traditional students. The average student in the MET and CIMT program is approximately 27 years of age. Additionally, the usual percentage of part-time students in these two degree programs is 60% (part-time is less than 12 credit hours per semester). However, analysis shows that the assessment exam score and time to degree completion measured in days has essentially no correlation with an $R^2 = 0.0142$ for the three offerings of the exam. However, the trend line for the data does exhibit a small negative slope. This can be interpreted that there is a very slight decrease in expected graduation examination score with extended time to complete degree. Chart 2 shows the relationship between a student's degree time to completion and MET graduation examination average score.

Chart 1. MET Graduation Exam and GPA Correlation Analysis
Fall 2001 through Fall 2002

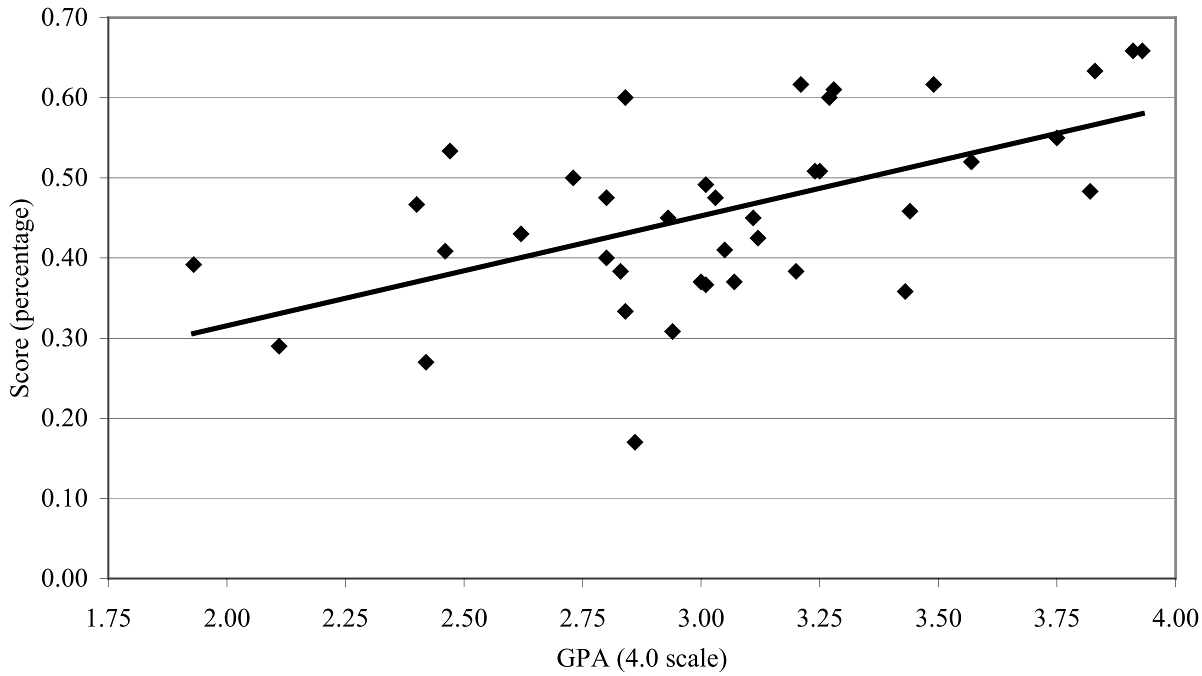
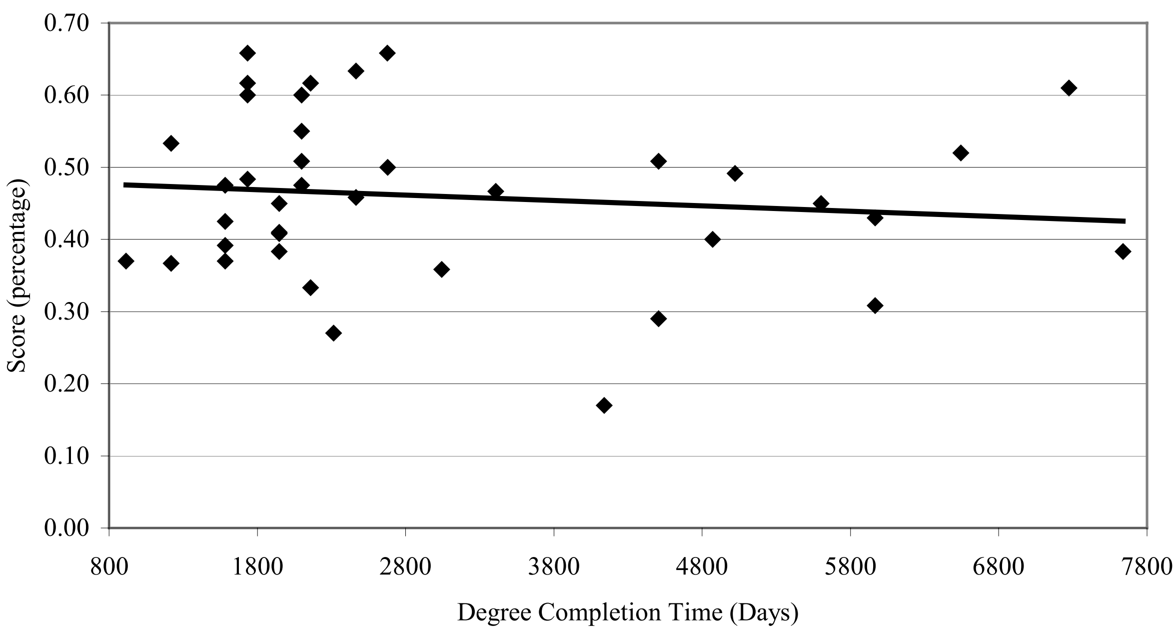


Chart 2. MET Graduation Exam Degree Completion Time Correlation Analysis
Fall 2001 through Fall 2002



The department faculty is continuing to evolve the evaluation and analysis methods used for the graduation examination. A planned study for exam validation will involve investigating the correlation between an individual student score in a subject area on the graduation examination with that student's grade in the subject. The study will also investigate any correlation between an individual student score in a subject area on the graduation examination with the length of time between the course and graduation examination.

Conclusions

Although the assessment exam has only been given for the past three semesters, its value as a measurement instrument in the continuous improvement process has become obvious. Statistical results show that there is positive correlation between student GPA and test results, however, not to the extent previously thought. The number of years that a student spends getting his or her degree was expected to have a negative impact on the student's exam grade, but actually showed almost no correlation at all. So far, only the overall results of the exam have been considered in possible program modifications. It is anticipated that the next step will be revision of individual courses based of feedback from the exam. This will be examined in the coming year.

Another benefit that is just beginning to be realized is that the exam has proven to be a positive motivational factor for students to retain knowledge from previous courses. Because the results of the exam make up 10% of a student's grade in the capstone course, students can no longer assume that once they have completed a course that they will never be asked to solve problems in that particular subject. It is expected that scores on the exam will rise slightly in the future as more underclassmen become aware of the exam.

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APPENDIX I - DEPARTMENT OF MECHANICAL ENGINEERING TECHNOLOGY
PLAN FOR ASSESSING GENERAL EDUCATION THROUGH THE PRINCIPLES OF UNDERGRADUATE LEARNING
MECHANICAL ENGINEERING TECHNOLOGY DEGREE PROGRAM

PRINCIPLES OF UNDERGRADUATE LEARNING		SPECIFIC MEASURABLE OUTCOME What will students be able to do that you will assess?	LOCATION Where is this material taught?	LOCATION Where is this material assessed?	ARTIFACTS OR EVIDENCE What will be collected and evaluated?	EVALUATION METHOD	LEVEL OF PERFORMANCE EXPECTED
#1	**Core Communications and Quantitative Skills**: The ability of students to write, read, speak, and listen, and perform quantitative analysis, and use information resources and technology.	1a. Express ideas and facts in a variety of written formats.	IET 104 MET 105 MET 111 MET 141 MET 220 MET 230 MET 242 MET 320 MET 350 MET 384 MET 414 TCM 220 TCM 340	TCM 220 TCM 340	Student Writing Projects	Standardized Evaluation Forms and Assessment Team	Score of 3 on 5 point scale.
		1b. Comprehend, interpret, and analyze texts.	CGT 110 IET 104 MET 102 MET 111 MET 141 MET 142 MET 220 MET 230 MET 242 MET 320 MET 344 MET 350 MET 384	MET 220 MET 350	Final Exam	Student Learning Evaluation Analysis	80% Success Rate
		1c. Communicate orally in one-on-one and group settings.	IET 104 MET 141 MET 142 MET 220 MET 230 MET 242 MET 320 MET 350 MET 384 MET 414 TCM 370	TCM 370	Student Oral Presentations	Standardized Evaluation Forms and Assessment Team	Score of 3 on 5 point scale.
		1d. Solve problems that are quantitative in nature.	CGT 110 IET 104 IET 150 MET 102 MET 105 MET 111 MET 141 MET 142 MET 220 MET 230 MET 240 MET 242 MET 320 MET 344 MET 350 MET 384 MET 414	MET 105	Final Exam	Student Learning Evaluation Analysis	80% Success Rate
		1e. Make efficient use of information resources and technology.	CGT 110 IET 104 MET 102 MET 105 MET 220 MET 230 MET 320 MET 350 MET 384 MET 414	MET 220 MET 350	Final Exam	Student Learning Evaluation Analysis	80% Success Rate

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	PRINCIPLES OF UNDERGRADUATE LEARNING	SPECIFIC MEASURABLE OUTCOME What will students be able to do that you will assess?	LOCATION Where is this material taught?	LOCATION Where is this material assessed?	ARTIFACTS OR EVIDENCE What will be collected and evaluated?	EVALUATION METHOD	LEVEL OF PERFORMANCE EXPECTED
#2	**Critical Thinking**: The ability to analyze complex issues and make informed decisions from multiple perspectives.	2a. Analyze complex issues and make informed decisions.	IET 104 MET 220 MET 230 MET 384 MET 414	MET 414	Comprehensive Examination	Results Analysis by Subject Area	70% Success Rate in Each Subject Area
		2b. Synthesize information in order to come to reasoned conclusions.	IET 104 IET 150 MET 102 MET 111 MET 220 MET 230 MET 384 MET 414	MET 414	Comprehensive Examination	Results Analysis by Subject Area	70% Success Rate in Each Subject Area
		2c. Evaluate the logic, validity and relevance of data.	IET 150 MET 105 MET 220 MET 230 MET 320 MET 350 MET 384 MET 414	MET 414	Comprehensive Examination	Results Analysis by Subject Area	70% Success Rate in Each Subject Area
		2d. Solve challenging problems.	IET 150 MET 102 MET 111 MET 220 MET 230 MET 320 MET 350 MET 384 MET 414	MET 414	Comprehensive Examination	Results Analysis by Subject Area	70% Success Rate in Each Subject Area
		2e. Use knowledge and understanding to generate and explore new questions.	IET 104 MET 220 MET 230 MET 320 MET 350 MET 384 MET 414	MET 414	Comprehensive Examination	Results Analysis by Subject Area	70% Success Rate in Each Subject Area
#3	**Integration and Application of Knowledge**: The ability to use information and concepts from studies in multiple disciplines in their intellectual, professional, and community lives.	3a. Apply knowledge to enhance personal lives, meet professional standards and competencies and further the goals of society.	CGT 110 IET 104 MET 102 MET 111 MET 344 MET 384 MET 414	MET 414	Senior Design Capstone Project	Standardized Evaluation Forms and Assessment Team	Score of 3 on 5 point scale.
#4	**Intellectual Depth, Breadth and Adaptiveness**: The ability of students to examine and organize disciplinary ways of knowing and to apply them to specific issues and problems.	4a. Demonstrate substantial knowledge and understanding of at least one field of study.	CGT 110 IET 150 MET 111 MET 220 MET 320 MET 414	MET 414	Comprehensive Examination	Results Analysis by Subject Area	70% Success Rate in Each Subject Area
		4b. Compare and contrast approaches to knowledge in different disciplines.	MET 414	MET 414	Senior Design Capstone Project	Standardized Evaluation Forms and Assessment Team	Score of 3 on 5 point scale.
		4c. Modify one's approach to an issue or problem based on the contexts and requirements of particular situations.	MET 102 MET 414	MET 414	Comprehensive Examination	Results Analysis by Subject Area	70% Success Rate in Each Subject Area

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PRINCIPLES OF UNDERGRADUATE LEARNING		SPECIFIC MEASURABLE OUTCOME What will students be able to do that you will assess?	LOCATION Where is this material taught?	LOCATION Where is this material assessed?	ARTIFACTS OR EVIDENCE What will be collected and evaluated?	EVALUATION METHOD	LEVEL OF PERFORMANCE EXPECTED
#5	**Understanding Society and Culture**: The ability to recognize their own cultural traditions and to understand and appreciate the diversity of the human experience, both within the United States and internationally.	5a. Compare and contrast the range of diversity and universality in human history, societies and ways of life.	Humanities and Social Science Electives	School of Liberal Arts			
		5b. Analyze and understand the interconnectedness of global and local concerns.	Humanities and Social Science Electives IET 104	School of Liberal Arts			
		5c. Operate with civility in a complex social world.	Humanities and Social Science Electives	School of Liberal Arts			
#6	**Values and Ethics**: The ability of students to make judgments with respect to individual conduct, citizenship and aesthetics.	6a. Make informed and principled choices regarding conflicting situations in their personal and public lives and to foresee the consequences of these choices.	Humanities and Social Science Electives	School of Liberal Arts			
		6b. Recognize the importance of aesthetics in their personal lives and to society.	MET 414	MET 414	Senior Design Capstone Project	Standardized Evaluation Forms and Assessment Team	Score of 3 on 5 point scale.

Course Titles:

MET 102	Production Drafting
MET 105	Introduction to Engineering Technology
MET 111	Applied Statics
MET 141	Materials and Processes I
MET 142	Materials I
MET 220	Heat and Power
MET 230	Fluid Power
MET 242	Manufacturing Processes II
MET 320	Thermodynamics
MET 344	Materials II
MET 350	Fluid Dynamics
MET 384	Instrumentation
MET 414	Senior Design
CGT 110	Graphics Communication
IET 104	Industrial Organization
IET 150	Quantitative Analysis for Technology
TCM 220	Technical Writing
TCM 240	Business Correspondence
TCM 370	Technical Oral Communications

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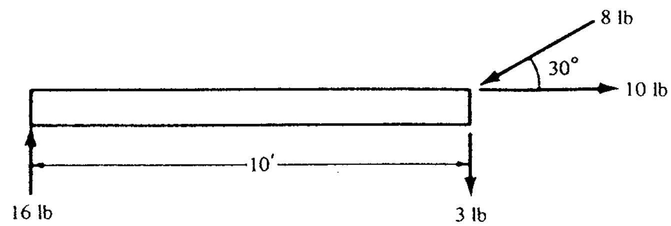
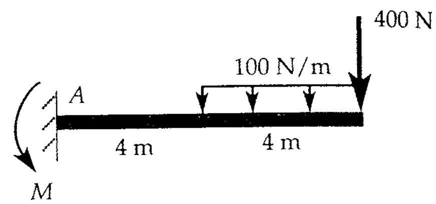
APPENDIX II - Mechanical Engineering Technology
Assessment Instrument - Excerpt

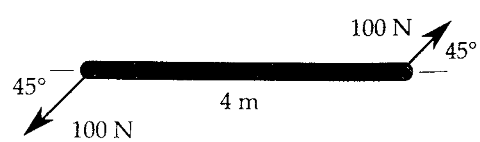
6. Consider a weightless bar with forces applied as shown below. Determine the magnitude of the resultant force.
   a) 19.2 lb, b) 9.5 lb, c) 13.4 lb, d) 8.5 lb.



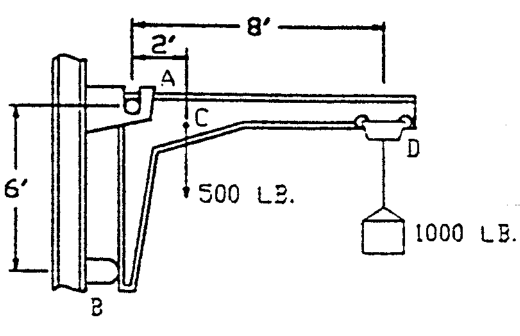
7. What moment M exists at the support A.
   a) 5,000 N-m, b) 4,400 N-m, c) 4,000 N-m, d) 5,600 N-m.



8. To ensure equilibrium, what couple must be applied to this member:
   a) 283 N-m ccw, b) 400 N-m cw, c) 283 N-m cw d) 400 N-m ccw.



9. Determine the magnitude of the horizontal reaction at point B.
   a) 1,500 lb, b) 1,750 lb, c) 2,000 lb, d) 2,200 lb.



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APPENDIX III - Computer Integrated Manufacturing Technology
Assessment Instrument – Excerpt

76. Which of the following is NOT an advantage of using an accumulator in a fluid power circuit?
a) Reduces water hammer in the line. b) Acts as an additional power source.
c) Acts as a heat dissipation device. d) Reduces the required capacity of the pump.

77. A flow control valve produces a pressure drop of 200 psig when oil of 0.85 specific gravity passes through it at 20 gpm. The capacity coefficient of the valve is:
a) 1.0 b) 1.3 c) 1.4 d) 1.5

78. Pilot-actuated valves are represented graphically by adding what to the valve symbol?
a) dashed line b) a solid line
c) an arrow to the valve d) an arrow away from the valve

79. A machine tool has an initial value of $100,000, an expected life of 7 years, with a salvage value of 11% of its first cost. Its operating costs are expected to be $10,000 per year. The desired rate of return is 15%. Determine the annual cost of the equipment including the return on investment.
a) $33,043 b) $27,540 c) $35,873 d) $32,346

80. Jane is buying a home that sells for $120,000. She has a $25,000 down payment and will borrow the remainder for 8% compounded monthly for 30 years. She will make equal monthly payments over the life of the loan. Over the 30-year period, her total interest on the loan is:
a) $136,140 b) $221,987 c) $224,777 d) $155,949

81. Bill wants to have $1,000,000 in his tax deferred IRA when he retires at age 65. He is currently 24 years old and plans on earning a return of 12% annually. What must be his annual deposit into the account?
a) $987 b) $1,163 c) $2,000 d) $1,345

82. A current machine was purchased 3 years ago for $150,000. The book value is currently $90,000. The market value is $75,000. Straight-line depreciation is used. The machine has 5 more years of service remaining with salvage of $10,000 at that time. Operating costs are $20,000 per year. A new piece of equipment can be purchased for $175,000 having a 12-year life with no salvage at that time. The annual operating costs are expected to be $12,000. If the desired ROI is 12%, determine the future annual costs of the existing and the new equipment.
a) $38,904 and $41,300 b) $40,251 and $41,300
c) $38,904 and $39,232 d) $39,232 and $40,251

83. Which of the following is a cutting tool material type consisting of pure aluminum oxide resulting in excellent hot hardness and abrasion resistance but low thermal and shock resistance?
a) High Speed Steel (HSS) b) Cast Cobalt Alloy c) Carbide d) Ceramic

84. Which of the following best describes the slow-death mechanism of tool failure?
a) Gradual tool wear - not predicable b) Fracture - not predicable
c) Gradual tool wear – predicable d) Fracture – predicable

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APPENDIX IV – MET EXAMINATION RESULTS

Question#	Course	Subject	F2001 Average[2]	S2002 Average[2]	F2002 Average[2]	Combined Average[2]	F2001 Average[2]	S2002 Average[2]	F2002 Average[2]	Combined Average[2]
1	CGT 110	Graphics	0.90	0.92	0.71	0.82				
2	CGT 110	Graphics	0.40	0.50	0.35	0.41				
3	CGT 110	Graphics	0.20	0.25	0.00	0.13				
4	CGT 110	Graphics	0.30	0.25	0.29	0.28				
5	CGT 110	Graphics	0.70	0.83	0.71	0.74				
51	CGT 110	Graphics	0.33	0.33	0.13	0.24				
52	CGT 110	Graphics	0.33	0.42	0.53	0.45				
53	CGT 110	Graphics	0.89	0.67	0.75	0.76				
54	CGT 110	Graphics	0.33	0.42	0.35	0.37				
55	CGT 110	Graphics	0.67	1.00	0.65	0.76	0.5056	0.5583	0.4463	0.4964
36	IET 350	Engr Econ	0.30	0.42	0.47	0.41				
37	IET 350	Engr Econ	0.40	0.42	0.73	0.54				
38	IET 350	Engr Econ	0.50	0.67	0.76	0.67				
39	IET 350	Engr Econ	0.90	0.75	0.71	0.77				
40	IET 350	Engr Econ	0.20	0.33	0.29	0.28				
86	IET 350	Engr Econ	0.00	0.17	0.07	0.08				
87	IET 350	Engr Econ	0.11	0.08	0.20	0.14				
88	IET 350	Engr Econ	0.33	0.33	0.47	0.39				
89	IET 350	Engr Econ	0.22	0.17	0.13	0.17				
90	IET 350	Engr Econ	0.00	0.17	0.27	0.17	0.2967	0.3500	0.4102	0.3613
6	MET 111	Statics	0.50	0.42	0.38	0.42				
7	MET 111	Statics	0.70	0.92	0.75	0.79				
8	MET 111	Statics	0.50	0.75	0.50	0.58				
9	MET 111	Statics	0.90	0.92	0.75	0.84				
10	MET 111	Statics	0.90	0.67	0.59	0.69				
56	MET 111	Statics	0.22	0.58	0.47	0.44				
57	MET 111	Statics	0.67		0.36	0.48				
58	MET 111	Statics	0.44	0.50	0.14	0.34				
59	MET 111	Statics	0.11	0.50	0.14	0.26				
60	MET 111	Statics	0.33	0.42	0.79	0.54	0.5278	0.6296	0.4858	0.5389
11	MET 211	Strength	0.70	0.83	0.65	0.72				
12	MET 211	Strength	0.60	0.75	0.40	0.57				
13	MET 211	Strength	0.40	0.67	0.56	0.55				
14	MET 211	Strength	0.56	0.75	0.25	0.49				
15	MET 211	Strength	0.50	1.00	0.56	0.68				
61	MET 211	Strength	0.56	0.50	0.29	0.43				
62	MET 211	Strength	0.44	0.58	0.21	0.40				
63	MET 211	Strength	0.11	0.50	0.21	0.29				
64	MET 211	Strength	0.00	0.08	0.07	0.06				
65	MET 211	Strength	0.11	0.75	0.21	0.37	0.3978	0.6417	0.3422	0.4552

[2] Adjusted Average – Omitted Questions Removed from Calculation