Session :

Curriculum Outcome Assesment using Subject Matter on the FE Examination.

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Abstract:

In engineering education, assessment has become a major topic as a result of the adoption of EC 2000 by The Accreditation Board for Engineering and Technology (ABET). In particular, the utilization of a nationally-normed examination is one method recommended by the ABET criteria[1]. In this regard, an effective and recognized tool for assessing engineering education is the Fundamentals of Engineering (FE) examination developed by the National Council of Examiners for Engineering and Surveying (NCEES). In this study, the findings of a detailed analysis of FE examination data of the students at Lamar University is conducted and presented in various forms. The investigation includes a discussion concerning the FE as an effective assessment tool and the development of a database of FE examination results. Fundamentals of Engineering examination data are presented in several forms to evaluate engineering student performance. First, a comparison of grades in individual subject areas (e.g chemistry, computers, dynamics, fluid mechanics, mathematics etc.) is conducted relative to the national average. This provides assessment information for a particular institution. Overall, the findings of the study indicate that the use of the subject matter on the FE exam to measure student performance yields considerable data for comparison purposes which may be utilized to asses and improve an engineering program.

I. Introduction:

Among the most significant obstacles facing universities, today, is related to developing quantitative measures for evaluating engineering student performance and tracking the effect of program changes in the curriculum[9]. Gaining faculty acceptance for the evaluation methodology utilized is also important. Here, many of the difficulties result from a lack of available uniform performance measures, across institutions. Presently, the only available uniform performance measure taken by a large number of students from many institutions is the Fundamentals of Engineering (FE) examination. Unfortunately, many educators and university administrators are principally concerned with only the overall pass rate on the FE examination. Numerous institutions use this single number as a performance measure for engineering programs[5,6,8]. For example the Texas Legislature has recommended that Texas Universities should be funded by a formula based, in part, on the student pass rate on the FE examination[12].

II. FE exam as an assessment tool:

The Fundamentals of Engineering examination is used, in part, as the first step in the professional licensing of engineers and was developed to measure minimum technical competence[2,4,10]. It is a pass/fail exam that is taken by approximately 50,000 people a year, most of whom are recent college graduates or seniors within one year of graduation. Although the exam results do provide specific data on performance in a given subject, this information is not used for licensing. The data can, however, be utilized to make comparisons and conclusions, some of which may or may not be valid. Most importantly, the FE exam results also provide information concerning the achievement of students taking the test relative to state and national averages.

In fact, the FE examination is the only nationally-normed exam that addresses specific engineering topics, which makes it an extremely attractive tool for use as part of an assessment process. Furthermore, the format of the FE exam was recently changed with the express purpose of making it more useful for outcomes assessment. Specifically, discipline specific sections for chemical, civil, electrical, industrial, and mechanical engineering were developed to include subjects from upper level courses --- topics that were not appropriate when students from all engineering disciplines took the same exam. This was done to better measure students knowledge of subjects taught in junior and senior level engineering courses. In addition to the above, the FE exam is currently under revision by the National Council of Examiners for Engineering and Surveying to increase its utility as a program evaluation tool.

FE exam results may be used to assess the following subject areas as specified in the ABET criterion.

a) An ability to apply knowledge of mathematics, science and engineering.
b) An ability to design and conduct experiments, as well as to analyze and interpret data
c) An ability to design a system, component, or process to meet desired needs
d) An ability to identify, formulate and solve engineering problems
e) An understanding of professional and ethical responsibility
f) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Some of the aforementioned subject areas may be covered in either or both the morning or afternoon sessions.

III. FE Pass Rate:

Although the FE exam provides some means of assessment, there are both advantages and disadvantages of using the exam as an assessment tool; therefore, its widespread use as such should be viewed with caution. The FE exam should not be used to determine the curricular content of a program—its original purpose is to test, in part, competency for licensure. In addition, the exam is not intended to force programs to be similar. For licensure purposes, the total score is used rather than the score in any specific subset of questions. Passing the exam does not show the competence in all subjects but instead shows an average minimum level of competency in several subject areas.

As mentioned, one of the major errors that could be made in using the FE exam as an assessment tool is focusing on the percentage who pass the exam[9]. This criterion is too broad to be effective in improving sub-discipline instruction. More specific measures are needed. Too often, the passing rates of individual programs are compared with those of other institutions, and these rates become more important than the subjects to be evaluated. In such a situation, the focus becomes "teaching to the exam" and not truly assessing the subject matter in the curriculum. In any case, institutions must remember that the original primary purpose of the FE is to assess minimal technical competencies of the various individuals sitting for the examination.

IV. FE Subject areas:

A database of FE examination scores for Civil Engineering students at Lamar University has recently been developed. The data for the six years between 1998 and 2003 was extracted from the NCEES documentation[3]. With this information, the average scores of students from Lamar University can be compared with the national averages. Tables 1-4 show the grades for each subject (e.g Chemistry, Computers, Dynamics, Electrical Circuits, Fluid Mechanics, Ethics, Statics etc.) for both the morning and the afternoon general examination sessions. Comparing the data between Tables 1 & 2, and that of Tables 3 & 4, it can be seen that Lamar University results tend to be above the national average for many subject areas. For example, in the 2003 morning exam, shown in Tables 1&2, Lamar students performed above the national average in these subjects: Chemistry (82.0% / 63.5%), Electrical Circuits (50.0% / 39.5%), Ethics (86.7% / 68.5%), Fluid Mechanics (54.7% / 53.0%), Mathematics (76.3% / 64.0%) and Thermodynamics (48.3% / 44.5%).

In order to reduce the volume of data and eliminate the importance of a single examination, three-year averages (2001 to 2003 and 1998 to 2000) were calculated. The results are illustrated in Tables 5-8. A comparison between Tables 5 & 6 indicates that the Lamar Civil Engineering scores tend to be generally higher than the national average for the morning examination. In fact, for the 2001-2003 time period, Lamar students earned lower scores in only three subject areas: Engineering Economy (62.2% / 64.7%), Material Science (48.8% / 53.5%) and Thermodynamics (43.1% / 47.0%). A comparison of the findings in Tables 7 & 8 for the afternoon general examination, however, show that the grades of Lamar students are generally lower than the national average for numerous subject areas. As an example, for the 2001-2003 time period Lamar students performed above the national average in only five of the twelve subjects under consideration.

The ratio of the scores for the various subject areas, earned by students of Lamar University compared to the national scores, for both the morning and afternoon sessions was also calculated. Here, a ratio of greater than unity indicates that the Lamar scores exceed the national averages. This approach is recommended by the NCEES as a method to illustrate and compare the performance of the students in a specific department[11]. For example, Table 9 illustrates that the Civil Engineering scores for 2001-2003 in Engineering Economy (0.96), Material Science/Structure of Matter (0.91) and Thermodynamics (0.92) were below the national average. Nevertheless, Table 10, the afternoon exam, shows for the three subjects under consideration that except for Material Science/Structure of Matter (0.90), Engineering Economy (1.06) and Thermodynamics (1.09) are above average.

Table 11 illustrates the data for the six-year period between 1998 – 2003. The findings show that the ratio for all subjects is greater than unity for morning exam. This indicates that the Civil Engineering students have performed better than the national average for this test. However, in the afternoon, only four subjects are above the national values. These findings show that for many students the afternoon general exam is more difficult than the morning test.

V. Summary and Conclusions:

One of the methods of assessment listed in the ABET criteria is student performance on nationally-normed examinations. The NCEES has developed, over the years, the FE examination, which is designed, in part, to satisfy the professional licensing process. In addition, the FE examination, today, is the only nationally-normed exam that addresses specific engineering topics. This makes it an extremely attractive tool for use as part of the assessment process for an engineering institution. However, it must be noted that the FE test was originally designed to measure minimal technical competency.

Lamar University has been utilizing the FE exam for numerous years. In fact, 524 students have sat for the examination since 1980. Data indicates that the pass rate of this group is 94.59%. From 1986 the pass rate of various disciplines was recorded by the College of Engineering. Since that time, 115 Civil Engineering students have taken the examination with an overall pass rate of 94.8%. This data must be transmitted, yearly, to the Texas State Legislative Board[7].

The NCEES recommends that the pass rate should not be utilized for assessment purposes. It is believed that a comparison of performance in individual subject areas yields more consistent results. Taking this concept under consideration, the department developed documentation that tabulates the Civil Engineering score in various subjects compared to the national scores in the identical subject areas. In addition, the ratios of the individual departmental scores to the national scores were calculated as shown in Tables 9-11. Utilizing this approach a ratio of equal to or greater than one indicates that the performance of Lamar students is equal to or exceeds the national average.

The faculty of the Civil Engineering department is considering establishing a goal that the ratio for each subject area should be equal to or greater than unity for either the morning or afternoon examination. The findings in Table 11 indicate that this has been accomplished, on average, in the morning exam for the six years between 1998-2003. Nevertheless, the afternoon ratios indicate that these exams have been more difficult for the students. However, Tables 9 & 10 show the goal has not been met for the three-year period, 1998-2000. Specifically, chemistry (0.94 / 0.76), dynamics (0.94 / 0.89) and mathematics (0.98 / 0.75) do not meet the criteria. However, these problems were solved during the 2001-2003 time period. Nevertheless, Material Science/Structure of Matter (0.91 / 0.90) does not meet the goal for 2001-2003. A new faculty member has been hired in the materials area which should solve this problem. Overall, the findings of this investigation indicate that the use of the FE exam to measure student performance yields considerable data for comparison purposes which may be utilized to assess and improve an engineering program.

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Table 1. Lamar Civil Engineering Grades: Morning session

SUBJECT	Oct-03	Apr-03	AVG	Oct-02	Apr-02	AVG	Apr-01	AVG	Oct-00	Apr-00	AVG	Oct-99	AVG	Apr-98	AVG
			2003			2002		2001			2000		1999		1998
CHEMISTRY	82	82	**82.0**	55	59	**57.7**	73	**73**	45	64	**49.8**	59	**59**	45	**45**
COMPUTERS	71	36	**47.7**	71	50	**57.0**	100	**100**	43	29	**39.5**	79	**79**	57	**57**
DYNAMICS	78	56	**63.3**	56	67	**63.3**	78	**78**	70	33	**60.8**	61	**61**	33	**33**
ELECTRICAL CIR.	50	50	**50.0**	33	38	**36.3**	58	**58**	61	42	**56.3**	42	**42**	42	**42**
ENGINEERING ECO.	60	20	**33.3**	80	70	**73.3**	80	**80**	100	40	**85.0**	70	**70**	80	**80**
ETHICS	100	80	**86.7**	40	60	**53.3**	80	**80**	53	80	**59.8**	85	**85**	100	**100**
FLUID MECHANICS	38	63	**54.7**	50	56	**54.0**	75	**75**	38	75	**47.3**	66	**66**	75	**75**
MAT SCI/ STR MAT.	75	38	**50.3**	25	19	**21.0**	75	**75**	71	63	**69.0**	72	**72**	75	**75**
MATHEMATICS	79	75	**76.3**	79	71	**73.7**	58	**58**	58	54	**57.0**	67	**67**	50	**50**
MECH OF MATL.	63	56	**58.3**	50	75	**66.7**	75	**75**	67	38	**59.8**	50	**50**	75	**75**
STATICS	50	58	**55.3**	75	75	**75.0**	58	**58**	67	50	**62.8**	85	**85**	75	**75**
THERMODYNAMICS	45	50	**48.3**	45	45	**45.0**	36	**36**	61	55	**59.5**	50	**50**	45	**45**

Table 2. National Grades: Morning session

SUBJECT	Oct-03	Apr-03	AVG	Oct-02	Apr-02	AVG	Apr-01	AVG	Oct-00	Apr-00	AVG	Oct-99	AVG	Apr-98	AVG
			2003			2002		2001			2000		1999		1998
CHEMISTRY	55	72	**63.5**	60	62	**61**	64	**64**	48	58	**53.0**	56	**56**	54	**54**
COMPUTERS	56	54	**55.0**	62	62	**62**	74	**74**	44	55	**49.5**	61	**61**	57	**57**
DYNAMICS	60	62	**61.0**	54	56	**55**	61	**61**	56	47	**51.5**	58	**58**	55	**55**
ELECTRICAL CIR.	37	42	**39.5**	38	42	**40**	56	**56**	37	41	**39.0**	41	**41**	45	**45**
ENGINEERING ECO.	63	59	**61.0**	69	67	**68**	65	**65**	56	58	**57.0**	57	**57**	61	**61**
ETHICS	63	74	**68.5**	66	62	**64**	80	**80**	74	73	**73.5**	80	**80**	80	**80**
FLUID MECHANICS	55	51	**53.0**	55	55	**55**	67	**67**	43	58	**50.5**	57	**57**	62	**62**
MAT SCI/ STR MAT.	55	52	**53.5**	48	48	**48**	59	**59**	49	49	**49.0**	60	**60**	54	**54**
MATHEMATICS	64	64	**64.0**	57	63	**60**	57	**57**	52	55	**53.5**	60	**60**	64	**64**
MECH OF MATL.	62	57	**59.5**	57	57	**57**	64	**64**	41	49	**45.0**	55	**55**	55	**55**
STATICS	55	56	**55.5**	64	64	**64**	49	**49**	54	44	**49.0**	71	**71**	59	**59**
THERMODYNAMICS	44	45	**44.5**	43	46	**44.5**	52	**52**	38	45	**41.5**	45	**45**	50	**50**

Table3. Lamar Civil Engineering Grades: Afternoon General Examination

SUBJECT		Apr-03	AVG		Apr-02	AVG	Apr-01	AVG	Oct-00	Oct-00	AVG	Oct-99	AVG	Apr-98	AVG
			2003			2002		2001			2000		1999		1998
CHEMISTRY		50	**50**		50	**50**	20	**20**	33	20	**29.8**	35	**35**	40	**40**
COMPUTERS		50	**50**		50	**50**	67	**67**	67	67	**67.0**	58	**58**	33	**33**
DYNAMICS		30	**30**		10	**10**	60	**60**	40	0	**30.0**	45	**45**	20	**20**
ELECTRICAL CIR.		8	**8**		33	**33**	17	**17**	67	17	**54.5**	21	**21**	50	**50**
ENGINEERING ECO.		50	**50**		67	**67**	33	**33**	56	33	**50.3**	58	**58**	0	**0**
ETHICS		67	**67**		67	**67**	67	**67**	78	100	**83.5**	75	**75**	100	**100**
FLUID MECHANICS		50	**50**		50	**50**	25	**25**	50	50	**50.0**	63	**63**	25	**25**
MAT SCI/ STR MAT.		67	**67**		33	**33**	33	**33**	67	33	**58.5**	75	**75**	0	**0**
MATHEMATICS		46	**46**		75	**75**	50	**50**	33	25	**31.0**	40	**40**	42	**42**
MECH OF MATL.		63	**63**		63	**63**	50	**50**	17	75	**31.5**	44	**44**	25	**25**
STATICS		42	**42**		58	**58**	100	**100**	72	83	**74.8**	79	**79**	50	**50**
THERMODYNAMICS		33	**33**		42	**42**	67	**67**	33	50	**37.3**	46	**46**	33	**33**

Table 4. National Grades: Afternoon General Examination

SUBJECT		Apr-03	AVG		Apr-02	AVG	Apr-01	AVG	Oct-00	Oct-00	AVG	Oct-99	AVG	Apr-98	AVG
			2003			2002		2001			2000		1999		1998
CHEMISTRY		50	**50**		39	**39**	57	**57**	44	43	**43.5**	40	**40**	54	**54**
COMPUTERS		76	**76**		59	**59**	63	**63**	36	56	**46.0**	56	**56**	65	**65**
DYNAMICS		37	**37**		39	**39**	40	**40**	40	34	**37.0**	45	**45**	25	**25**
ELECTRICAL CIR.		37	**37**		45	**45**	27	**27**	32	37	**34.5**	29	**29**	41	**41**
ENGINEERING ECO.		54	**54**		50	**50**	39	**39**	40	38	**39.0**	41	**41**	38	**38**
ETHICS		65	**65**		66	**66**	74	**74**	82	77	**79.5**	70	**70**	88	**88**
FLUID MECHANICS		42	**42**		54	**54**	34	**34**	40	31	**35.5**	58	**58**	56	**56**
MAT SCI/ STR MAT.		62	**62**		49	**49**	36	**36**	30	61	**45.5**	53	**53**	43	**43**
MATHEMATICS		47	**47**		62	**62**	52	**52**	42	49	**45.5**	54	**54**	51	**51**
MECH OF MATL.		25	**25**		52	**52**	49	**49**	34	48	**41.0**	42	**42**	34	**34**
STATICS		51	**51**		64	**64**	41	**41**	60	55	**57.5**	53	**53**	61	**61**
THERMODYNAMICS		40	**40**		45	**45**	45	**45**	27	33	**30.0**	35	**35**	37	**37**

Table 5. Lamar Civil Engineering Grades (Three Year Average): Morning Session

SUBJECT	2003	2002	2001	AVG 2001-2003	2000	1999	1998	AVG 1998-2000
CHEMISTRY	82.0	57.7	73	**70.9**	49.8	59	45	**51.3**
COMPUTERS	47.7	57.0	100	**68.2**	39.5	79	57	**58.5**
DYNAMICS	63.3	63.3	78	**68.2**	60.8	61	33	**51.6**
ELECTRICAL CIR.	50.0	36.3	58	**48.1**	56.3	42	42	**46.8**
ENGINEERING ECO.	33.3	73.3	80	**62.2**	85.0	70	80	**78.3**
ETHICS	86.7	53.3	80	**73.3**	59.8	85	100	**81.6**
FLUID MECHANICS	54.7	54.0	75	**61.2**	47.3	66	75	**62.8**
MAT SCI/ STR MAT.	50.3	21.0	75	**48.8**	69.0	72	75	**72.0**
MATHEMATICS	76.3	73.7	58	**69.3**	57.0	67	50	**58.0**
MECH OF MATL.	58.3	66.7	75	**66.7**	59.8	50	75	**61.6**
STATICS	55.3	75.0	58	**62.8**	62.8	85	75	**74.3**
THERMODYNAMICS	48.3	45.0	36	**43.1**	59.5	50	45	**51.5**

Table 6. National Grades (Three Year Average): Morning Session

SUBJECT	2003	2002	2001	AVG 2001-2003	2000	1999	1998	AVG 1998-2000
CHEMISTRY	63.5	61	64	**62.8**	53.0	56	54	**54.3**
COMPUTERS	55.0	62	74	**63.7**	49.5	61	57	**55.8**
DYNAMICS	61.0	55	61	**59.0**	51.5	58	55	**54.8**
ELECTRICAL CIR.	39.5	40	56	**45.2**	39.0	41	45	**41.7**
ENGINEERING ECO.	61.0	68	65	**64.7**	57.0	57	61	**58.3**
ETHICS	68.5	64	80	**70.8**	73.5	80	80	**77.8**
FLUID MECHANICS	53.0	55	67	**58.3**	50.5	57	62	**56.5**
MAT SCI/ STR MAT.	53.5	48	59	**53.5**	49.0	60	54	**54.3**
MATHEMATICS	64.0	60	57	**60.3**	53.5	60	64	**59.2**
MECH OF MATL.	59.5	57	64	**60.2**	45.0	55	55	**51.7**
STATICS	55.5	64	49	**56.2**	49.0	71	59	**59.7**
THERMODYNAMICS	44.5	44.5	52	**47.0**	41.5	45	50	**45.5**

Table 7. LamarCivil engineering Grades (Three year Average): Afternoon Session

SUBJECT	2003	2002	2001	AVG 2001-2003	2000	1999	1998	AVG 1998-2000
CHEMISTRY	50	50	20	**40.0**	29.8	35	40	**34.9**
COMPUTERS	50	50	67	**55.7**	67.0	58	33	**52.7**
DYNAMICS	30	10	60	**33.3**	30.0	45	20	**31.7**
ELECTRICAL CIR.	8	33	17	**19.3**	54.5	21	50	**41.8**
ENGINEERING ECO.	50	67	33	**50.0**	50.3	58	0	**36.1**
ETHICS	67	67	67	**67.0**	83.5	75	100	**86.2**
FLUID MECHANICS	50	50	25	**41.7**	50.0	63	25	**46.0**
MAT SCI/ STR MAT.	67	33	33	**44.3**	58.5	75	0	**44.5**
MATHEMATICS	46	75	50	**57.0**	31.0	40	42	**37.7**
MECH OF MATL.	63	63	50	**58.7**	31.5	44	25	**33.5**
STATICS	42	58	100	**66.7**	74.8	79	50	**67.9**
THERMODYNAMICS	33	42	67	**47.3**	37.3	46	33	**38.8**

Table 8. National Grades (Three year Average): Afternoon Session

SUBJECT	2003	2002	2001	AVG 2001-2003	2000	1999	1998	AVG 1998-2000
CHEMISTRY	50	39	57	**48.7**	43.5	40	54	**45.8**
COMPUTERS	76	59	63	**66.0**	46.0	56	65	**55.7**
DYNAMICS	37	39	40	**38.7**	37.0	45	25	**35.7**
ELECTRICAL CIR.	37	45	27	**36.3**	34.5	29	41	**34.8**
ENGINEERING ECO.	54	50	39	**47.7**	39.0	41	38	**39.3**
ETHICS	65	66	74	**68.3**	79.5	70	88	**79.2**
FLUID MECHANICS	42	54	34	**43.3**	35.5	58	56	**49.8**
MAT SCI/ STR MAT.	62	49	36	**49.0**	45.5	53	43	**47.2**
MATHEMATICS	47	62	52	**53.7**	45.5	54	51	**50.2**
MECH OF MATL.	25	52	49	**42.0**	41.0	42	34	**39.0**
STATICS	51	64	41	**52.0**	57.5	53	61	**57.2**
THERMODYNAMICS	40	45	45	**43.3**	30.0	35	37	**34.0**

Table 9.Three Year ratios: Morning Examination

SUBJECT	2003	2002	2001	AVG 2001-2003		2000	1999	1998	AVG 1998-2000
CHEMISTRY	1.29	0.95	1.14	**1.13**		0.94	1.05	0.83	**0.94**
COMPUTERS	0.87	0.92	1.35	**1.07**		0.80	1.30	1.00	**1.05**
DYNAMICS	1.04	1.15	1.28	**1.16**		1.18	1.05	0.60	**0.94**
ELECTRICAL CIR.	1.27	0.91	1.04	**1.07**		1.44	1.02	0.93	**1.12**
ENGINEERING ECO.	0.55	1.08	1.23	**0.96**		1.49	1.23	1.31	**1.34**
ETHICS	1.27	0.83	1.00	**1.04**		0.81	1.06	1.25	**1.05**
FLUID MECHANICS	1.03	0.98	1.12	**1.05**		0.94	1.16	1.21	**1.11**
MAT SCI/ STR MAT.	0.94	0.44	1.27	**0.91**		1.41	1.20	1.39	**1.33**
MATHEMATICS	1.19	1.23	1.02	**1.15**		1.07	1.12	0.78	**0.98**
MECH OF MATL.	0.98	1.17	1.17	**1.11**		1.33	0.91	1.36	**1.19**
STATICS	1.00	1.17	1.18	**1.12**		1.28	1.20	1.27	**1.24**
THERMODYNAMICS	1.09	1.01	0.69	**0.92**		1.43	1.11	0.90	**1.13**

Table 10.Three Year Ratios: Afternoon General Exam

SUBJECT	2003	2002	2001	AVG 2001-2003		2000	1999	1998	AVG 1998-2000
CHEMISTRY	1.00	1.28	0.35	**0.82**		0.68	0.88	0.74	**0.76**
COMPUTERS	0.66	0.85	1.06	**0.84**		1.46	1.04	0.51	**0.95**
DYNAMICS	0.81	0.26	1.50	**0.86**		0.81	1.00	0.80	**0.89**
ELECTRICAL CIR.	0.22	0.73	0.63	**0.53**		1.58	0.72	1.22	**1.20**
ENGINEERING ECO.	0.93	1.34	0.85	**1.05**		1.29	1.41	0.00	**0.92**
ETHICS	1.03	1.02	0.91	**0.98**		1.05	1.07	1.14	**1.09**
FLUID MECHANICS	1.19	0.93	0.74	**0.96**		1.41	1.09	0.45	**0.92**
MAT SCI/ STR MAT.	1.08	0.67	0.92	**0.90**		1.29	1.42	0.00	**0.94**
MATHEMATICS	0.98	1.21	0.96	**1.06**		0.68	0.74	0.82	**0.75**
MECH OF MATL.	2.52	1.21	1.02	**1.40**		0.77	1.05	0.74	**0.86**
STATICS	0.82	0.91	2.44	**1.28**		1.30	1.49	0.82	**1.19**
THERMODYNAMICS	0.83	0.93	1.49	**1.09**		1.24	1.31	0.89	**1.14**

	Table 11. Six Year Ratios					
SUBJECT		MORNING				AFTERNOON
CHEMISTRY		1.04			0.79	
COMPUTERS		1.06			0.89	
DYNAMICS		1.05			0.87	
ELECTRICAL CIR.		1.09			0.86	
ENGINEERING ECO.		1.14			0.99	
ETHICS		1.04			1.04	
FLUID MECHANICS		1.08			0.94	
MAT SCI/ STR MAT.		1.12			0.92	
MATHEMATICS		1.07			0.91	
MECH OF MATL.		1.15			1.14	
STATICS		1.18			1.23	
THERMODYNAMICS		1.02			1.11	