

Curricula comparison of mechanical engineering technology and similarly named programmes

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ABSTRACT: In this article, the author presents a curricula comparison study of the historically Accreditation Board for Engineering and Technology (ABET) accredited Mechanical Engineering Technology programme at Applied College in the University of Hafr Al Batin, the currently ABET-accredited Mechanical Maintenance Engineering Technology programme at Jubail Industrial College, and the currently ABET-accredited Mechanical Maintenance Technology programme at Yanbu Industrial College. In this curricula comparison, the author has analysed in finer details the respective general and core requirements of these engineering technology programmes offered at different colleges in the Kingdom of Saudi Arabia. The analysis presented in this article may be applied in a similar manner to other engineering technology programmes preparing for ABET accreditation.

INTRODUCTION

Curricula comparison among similarly named programmes is an important topic. Tsai and Wang compared the curricula of the Mechanical Engineering Bachelor's degree programme at the Ming Chi University of Technology in Taiwan and the Mechanical Engineering Technology Bachelor's degree programme at Purdue University in the USA [1]. In their recent publications, the author of the current article and others, described in detail the faculty course assessment report methodology for the assessment of student outcomes, while pursuing for the Accreditation Board for Engineering and Technology (ABET) accreditation of the Electrical and Electronics Engineering Technology (EEET) programme at Applied College in the University of Hafr Al Batin [2][3].

The rubrics-based direct assessment process of ABET student outcomes of the EEET programme at Applied College was described in detail by the author of the current article and another author [4]. The curricula of the historically ABET-accredited EEET programme at Applied College, the currently ABET-accredited Instrumentation and Control Engineering Technology programme at Jubail Industrial College, and the currently ABET-accredited Electronics and Communication Technology programme and Instrumentation and Control Technology programme at Yanbu Industrial College have been compared by the author of the current article and another author [5].

MECHANICAL ENGINEERING TECHNOLOGY PROGRAMME

The Mechanical Engineering Technology (MET) programme at Applied College in the University of Hafr Al Batin was proposed and developed according to a memorandum of understanding (MoU) between the Applied College and Saudi Aramco in order to prepare the MET graduates for mechanical inspection jobs at Saudi Aramco [6].

The MET Department at Applied College has employed the industry job requirements and the competencies as a basis for the development of the MET programme in line with the MoU. The MET programme is designed to have a competitive edge over the existing similarly named programmes at Jubail Industrial College and Yanbu Industrial College.

The MET programme at Applied College is operational since the fall of 2016 and requires 22 courses, which together constitute 66 credit hours [7]. The general and core requirements of the historically ABET-accredited [8] MET programme at Applied College are discussed below.

General Requirements

The lecture hours (LT), laboratory hours (LB) and credit hours (CH) for the general and free elective requirements of the MET programme are shown in Table 1. As can be seen from this table, the nine general courses constitute 27 credit hours. Currently, the free elective course for the general requirements of the MET programme is Computer Applications I,

which is of three credit hours. Therefore, the total lecture hours and laboratory hours in Table 1 will add up to 22 and 15, respectively [7].

The Computer Applications I course is offered by the Computer Science and Engineering Technology Department of Applied College. However, the other three departments of Applied College including the MET Department may choose to propose free elective courses.

Table 1: General and free elective requirements of the MET programme at Applied College.

Code	Title	LT	LB	CH	Prerequisite	Semester
ENGL 161	English Composition I	3	0	3		1st
IAS 100	Islamic Ideology	2	0	2		1st
MATH 151	Applied Calculus	3	3	4		1st
PHYS 151	Principles of Physics	3	3	4		1st
EEET 110	Introduction to Electricity and Electronics	2	3	3	MATH 151	2nd
ENGL 171	English Composition II	3	0	3	ENGL 161	2nd
IAS 110	Objective Writing	2	0	2		2nd
CSET 121	Introduction to Computer Programming	2	3	3		2nd
OA 101	Computer Applications I	2	3	3		2nd
	Total	22	15	27		

Core Requirements

The lecture hours, laboratory hours and credit hours for the core and technical elective requirements of the MET programme are shown in Table 2 and Table 3, respectively. As can be seen from Table 2, the 13 core courses constitute 39 credit hours. As per the MET degree plan, the prerequisites for MET 291 and MET 299 courses are the completion of 40 and 50 credit hours, respectively, and/or MET Department approval [7].

Table 2: Core requirements of the MET programme at Applied College.

Code	Title	LT	LB	CH	Prerequisite	Semester
MET 106	Computer Aided Drafting	1	3	2		1st
MET 101	Industrial Safety	2	0	2		2nd
MET 217	Materials Technology	3	3	4	PHYS 151	3rd
MET 220	Applied Mechanics	3	3	4	MATH 151, PHYS 151	3rd
MET 223	Applied Thermo-Fluids	3	3	4	MATH 151, PHYS 151	3rd
MET 227	Troubleshooting and Maintenance	1	6	3		3rd
MET 236	Thermal Systems Performance	3	3	4	MET 223	4th
MET 277	Welding and Forming	2	3	3	MET 217	4th
MET 279	Machining Technology	2	3	3	MET 217	4th
MET 291	Applied Project	0	6	2	Completed 40 credit hours	4th
MET xxx	Elective I	2	3	3	Refer to Table 3	4th
MET xxx	Elective II	2	3	3	Refer to Table 3	4th
MET 299	Summer Training	0	40	2	Completed 50 credit hours	Summer
	Total	24	79	39		

Table 3: Technical elective requirements of the MET programme at Applied College.

Code	Title	LT	LB	CH	Prerequisite	Semester
MET 239	Industrial Hydraulics and Pneumatics	2	3	3	MET 223	4th
MET 262	Vibration in Machines	2	3	3	MET 220	4th
MET 265	Welding Inspection I and II	2	3	3	MET 217	4th
MET 272	Instrumentation and Measurement	2	3	3	MET 223	4th
MET 286	Automotive Technology	2	3	3	MET 223	4th

Before entering the MET programme at Applied College all students undergo a mandatory one-year preparatory programme, which prepares the students for successful college or university level studies. During the preparatory year, students must take two mathematics courses; namely, Preparatory Mathematics I (MATH 001) and Preparatory Mathematics II (MATH 002). In these two preparatory mathematics courses, students learn college-level algebra and trigonometry. Therefore, all students majoring in the MET programme at Applied College must take Applied Calculus (MATH 151) as one of the general requirements in the first semester, which is of course above the level of algebra and trigonometry. It is, therefore, concluded that the curriculum of the MET programme at Applied College satisfies the

mathematics requirement as stated in the General Criterion 5-Curriculum of the Engineering Technology Accreditation Commission (ETAC) of ABET.

MECHANICAL MAINTENANCE ENGINEERING TECHNOLOGY PROGRAMME

The Jubail Industrial College (JIC) was established by the Royal Commission for Jubail and Yanbu to meet the skilled and technical manpower needs of Jubail Industrial City, the world's largest industrial city. The Mechanical Maintenance Engineering Technology (MMET) programme requires 30 courses, which together constitute 73 credit hours [9].

The general and core requirements of the currently ABET-accredited [8] MMET programme at JIC are discussed below.

General Requirements

The lecture hours, laboratory hours and credit hours for the general and free elective courses of the MMET programme are shown in Table 4 and Table 5, respectively. As can be seen from Table 4, the 12 general courses constitute 31 credit hours. Depending on the free elective course on offer shown in Table 5 the total lecture hours and laboratory hours in Table 4 will add up to 21 to 22 and 27 to 29, respectively [9].

Table 4: General requirements of the MMET programme at JIC.

Code	Title	LT	LB	CH	Prerequisite	Semester
ELC 103	English III	2	3	3		1st
GES 103	Physical Education	0	2	1		1st
GES 113	Calculus I	3	3	4	GES 022	1st
GES 132	Fundamentals of Physics	3	4	4		1st
EEE 101	Electrical Circuits I	2	3	3		2nd
ELC 104	English IV	2	3	3	ELC 103	2nd
GES 151	General Chemistry	2	4	3		2nd
ELC 205	Technical Writing	2	3	3	ELC 104	3rd
MIT 170	Computer Applications	0	2	1		3rd
GES 271	Islamic Culture	1	0	1		4th
MIT 203	Organisational Behaviour and Ethics	2	0	2	ELC 103	4th
XXX xxx	Elective	x	x	3	Refer to Table 5	4th
	Total	19+x	27+x	31		

Table 5: Free elective requirements of the MMET programme at JIC.

Code	Title	LT	LB	CH	Prerequisite	Semester
MIT 101	Management Theory and Practice	3	0	3		4th
MIT 121	Principles of Marketing	3	0	3		4th
MIT 142	Principles of Economics	3	0	3		4th
MIT 175	Soft Skills	3	0	3		4th
MIT 215	Management Information System	3	0	3		4th
MIT 217	Business English Correspondence	2	2	3	ELC 205	4th
MIT 264	Enterprise Resource Planning	2	2	3		4th

Core Requirements

The lecture hours, laboratory hours and credit hours for the core requirements of the MMET programme are shown in Table 6. As can be seen from this table, the 18 core courses constitute 42 credit hours [9].

Table 6: Core requirements of the MMET programme at JIC.

Code	Title	LT	LB	CH	Prerequisite	Semester
MME 101	Engineering Drawing	0	2	1		1st
MME 102	Workshop Technology	0	2	1		1st
MME 103	Industrial Safety and Environment	1	0	1		1st
MME 121	Plant Maintenance	2	2	3		1st
MME 105	Introduction to Engineering Materials	1	0	1		2nd
MME 132	Fluid Mechanics	2	2	3	GES 132	2nd
MME 133	Computer Aided Drafting	0	3	1	MME 101	2nd
MME 134	Applied Mechanics	1	2	2	GES 132	2nd

EEE 222	Electrical Machines and Control	2	3	3	EEE 101	3rd
MME 112	Strength of Materials	2	3	3	GES 113, MME 134	3rd
MME 131	Applied Thermodynamics	2	2	3	GES 132	3rd
MME 205	Metrology and Quality Control	1	2	2	MME 102	3rd
MME 221	Pumping Machinery and Installations	2	3	3	MME 132	3rd
MME 232	Hydraulics and Pneumatics	2	2	3		4th
MME 233	MMET Project	0	4	2	ELC 205, MME 112	4th
MME 235	Industrial Compressors	2	2	3	MME 131	4th
MME 237	Power Generation Systems	3	4	4	MME 131	4th
MME 291	Cooperative Work Experience	0	40	3		Summer
	Total	23	78	42		

MECHANICAL MAINTENANCE TECHNOLOGY PROGRAMME

The Yanbu Industrial College (YIC) was established by the Royal Commission for Jubail and Yanbu to meet the skilled and technical manpower needs of Yanbu Industrial City, one of the world's largest industrial cities. The Mechanical Maintenance Technology (MMT) programme requires 27 courses, which together constitute 70 credit hours [10].

The general and core requirements of the currently ABET-accredited [8] MMT programme at YIC are discussed below.

General Requirements

The lecture hours, laboratory hours and credit hours for the general requirements of the MMT programme are shown in Table 7. As can be seen from this table, the 11 general courses constitute 28 credit hours [10].

Table 7: General requirements of the MMT programme at YIC.

Code	Title	LT	LB	CH	Prerequisite	Semester
ENG 101	English Communication	2	0	2		1st
GSMA 101	Calculus I	3	0	3		1st
GSPH 101	General Physics	3	3	4		1st
GSPE 101	Physical Education I	0	2	1		1st
GSCH 101	General Chemistry	3	3	4		2nd
ENG 102	English Composition	2	0	2	ENG 101	2nd
GSMA 102	Calculus II	3	0	3	GSMA 101	2nd
GSST 201	Applied Statistics	2	0	2	GSMA 102	3rd
ELET 104	Computer Programming	1	3	2		3rd
ENG 201	Technical Report Writing	3	0	3	ENG 102	4th
GSIS 101	Islamic Ideology and Thoughts	2	0	2		4th
	Total	24	11	28		

Core Requirements

The lecture hours, laboratory hours and credit hours for the core and technical elective requirements of the MMT programme are shown in Table 8 and Table 9, respectively. As can be seen from Table 8, the 16 core courses constitute 42 credit hours [10].

Table 8: Core requirements of the MMT programme at YIC.

Code	Title	LT	LB	CH	Co-requisite	Prerequisite	Semester
ENGT 101	Engineering Drafting	1	3	2			1st
MCET 101	Plant Maintenance	2	3	3	MCET 102		1st
MCET 102	Mechanical Measurements	1	3	2			1st
MCET 103	Machining Processes I	2	3	3	MCET 104	MCET 102	2nd
MCET 104	Materials Technology	2	3	3	GSCH 101		2nd
MCET 105	Applied Statics	3	0	3		GSPH 101, GSMA 101	2nd
ENGT 201	Industrial Safety	0	2	1		ENG 102	3rd
ELET 204	Industrial Electricity	2	3	3			3rd
MCET 201	Mechanical Drafting	1	3	2		ENGT 101	3rd
MCET 211	Applied Thermodynamics	2	3	3		MCET 101, MCET 104	3rd
MCET 212	Fluid Machines	2	3	3	MCET 211	MCET 101, MCET 104	3rd

ENGT 202	Industrial Supervision	1	0	1		ENG 102	4th
MCET 213	Equipment Maintenance	2	6	4	MCET 214	MCET 211, MCET 212	4th
MCET 214	Heat Exchangers	2	3	3		MCET 211, MCET 212	4th
MCET 2xx	Technical Elective	2	3	3		Refer to Table 9	4th
MCET 310	Co-op Training	0	40	3		Completed 67 credit hours	Summer
	Total	25	81	42			

Table 9: Technical elective requirements of the MMT programme at YIC.

Code	Title	LT	LB	CH	Co-requisite	Prerequisite	Semester
MCET 217	Refrigeration and Air Conditioning Technology	2	3	3	MCET 214	MCET 212	4th
MCET 219	Hydraulics and Pneumatics Technology	2	3	3		MCET 201, MCET 212	4th
MCET 222	Applied Strength of Materials	2	3	3		MCET 104, MCET 105	4th

CURRICULA COMPARISON

The required number of general, core and total courses/laboratory courses in the MET, MMET and MMT programmes at Applied College, JIC and YIC, respectively, are shown in Table 10. Depending on the free elective course on offer shown in Table 1, the general and total laboratory courses in Table 10 will add up to five and 17, respectively. Further, depending on the free elective course on offer shown in Table 5, the general and total laboratory courses in Table 10 will add up to nine to ten and 25 to 26, respectively. Also, as can be seen from this table, the MET programme at Applied College has the least number of total courses as compared to the MMET and MMT programmes at JIC and YIC, respectively.

Table 10: Required number of general, core and total courses/laboratory courses.

Programme	General courses	General laboratory courses	Core courses	Core laboratory courses	Total courses	Total laboratory courses
MET	9	4 + x	13	12	22	16 + x
MMET	12	9 + x	18	16	30	25 + x
MMT	11	4	16	14	27	18

The required number of free and technical elective courses in the MET, MMET and MMT programmes at Applied College, JIC and YIC, respectively, are shown in Table 11. As can be seen from this table, the MET programme at Applied College offers both free and technical elective courses as compared to the MMET and MMT programmes at JIC and YIC, respectively.

Table 11: Required number of free and technical elective courses.

Programme	Free elective courses	Technical elective courses
MET	1	2
MMET	1	-
MMT	-	1

The weekly required number of lecture hours, laboratory hours and total hours for general and core courses in the MET, MMET and MMT programmes are shown in Table 12. In all these programmes, the co-op or summer training students are required to spend 40 hours per week (eight hours per day for five working days) during their training period. Therefore, in Table 12 the laboratory hours for all these programmes are calculated by including these 40 hours. Also, as can be seen from this table, the MMET programme at JIC has the highest weekly required number of total hours for general courses as compared to the MET and MMT programmes at Applied College and YIC, respectively. Moreover, the weekly required number of lecture hours, laboratory hours and total hours for core courses of the MET programme at Applied College are very closely placed in between those of the MMET and MMT programmes at JIC and YIC, respectively.

Table 12: Weekly required number of lecture, laboratory and total hours for general and core courses.

Programme	Lecture hours		Laboratory hours		Total hours	
	General	Core	General	Core	General	Core
MET	22	24	15	79	37	103
MMET	21 to 22	23	27 to 29	78	49 to 50	101
MMT	24	25	11	81	35	106

The required number of general, core and total credit hours in the MET, MMET and MMT programmes at Applied College, JIC and YIC are shown in Table 13, respectively. As can be seen from this table, the MET programme at Applied College has the least number of total credit hours as compared to the MMET and MMT programmes at JIC and YIC, respectively. Note that the MET programme at Applied College was historically accredited by the ETAC of ABET until 30 September 2020. The historical accreditation of the MET programme at Applied College by the ETAC of ABET provided assurance that the programme met the quality standards of the mechanical engineering technology profession for which the programme prepared its graduates during the accreditation period.

Table 13: Required number of general, core and total credit hours.

Programme	General credit hours	Core credit hours	Total credit hours
MET	27	39	66
MMET	31	42	73
MMT	28	42	70

Note that the 2022-2023 ABET ETAC criteria for accrediting engineering technology programmes is being referred to in this article. As per the General Criterion 5 - Curriculum of the ETAC of ABET, the discipline-specific content of the curriculum must represent at least one-third of the total credit hours for the curriculum but no more than two-thirds of the total credit hours for the curriculum [11].

The discipline-specific content credit hours in the MET, MMET and MMT programmes at Applied College, JIC and YIC are shown in Table 14, respectively. As can be seen from this table, the currently ABET-accredited MMET and MMT programmes at JIC and YIC, respectively, satisfy the discipline-specific content Part-A of the General Criterion 5 - Curriculum of the ETAC of ABET as expected. Moreover, the MET programme at Applied College also satisfies the discipline-specific content Part-A of the General Criterion 5 - Curriculum of the ETAC of ABET [11].

Table 14: Discipline-specific content credit hours.

Programme	Total credit hours	1/3rd of the total credit hours	2/3rd of the total credit hours	Core credit hours
MET	66	22	44	39
MMET	73	24.33	48.67	42
MMT	70	23.33	46.67	42

CONCLUSIONS

It has been shown in the article that the MET programme at Applied College in the University of Hafr Al Batin satisfies the discipline-specific content Part-A of the General Criterion 5 - Curriculum of the ETAC of ABET. It can also be concluded that the MET programme at Applied College satisfies the mathematics requirement for associate degree curricula as stated in the General Criterion 5 - Curriculum of the ETAC of ABET.

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