

A COMPARATIVE STUDY OF ABET ACCREDITED ASSOCIATE DEGREE PROGRAMS, EVIDENCE FROM SAUDI ARABIA

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ABSTRACT

In this paper, we will present a comparative study of all the Accreditation Board for Engineering and Technology accredited associate degree programs at Yanbu Industrial College, Jubail Industrial College, and Hafr Al-Batin Community College, all located in the Kingdom of Saudi Arabia. In this comparison, we will look at some similarities and differences among these accredited associate degree programs. Moreover, we will also present some salient features of all the accredited associate degree programs at those three colleges. Finally, we hope that our study will benefit other community, industrial, and technical colleges seeking accreditation at the associate degree program level.

JEL: A1, A2, A3, H8, Y9

KEYWORDS: Accreditation, Associate Degree Programs, Curriculum Design, Engineering Technology

INTRODUCTION

As colleges and schools seek accreditation (institutional or program level) and highlights their achievements in this regard, we need to explore this issue in details. We will try to answer the questions: what does it mean to be accredited? How is this reflected in the programs? What accredited programs share in common? With the expansion of the post-secondary institution in terms of the number and formats (traditional vs. online or distance education) came the idea of quality assurance. This can be achieved through internal bodies (department, college, university level) or through external bodies (professional, national, regional, or international). Based on a predefined standard or criteria, the quality of the program of the institution is to be recognized. This will help the institution improves its facility, programs, reputation, and environment by benchmarking with other regional and international schools (Dodridge, 2002, Szanto, 2005, Young, 1983). Assessing the program outcomes is not an easy task. It is a continuous and tedious process. As such, it requires implementing quality factors deep in the details of the programs (Mourtos, 2006, Van Duzer, 2000). Accreditation Board for Engineering and Technology known short as ABET is accrediting post-secondary programs in the fields of applied science, computing, engineering, and engineering technology. ABET has been recognized by the Council for Higher Education Accreditation (CHEA) since 1997.

Also, ABET evaluates programs offered in a 100-percent online format. As of December 2016, 3709 programs at 752 colleges and universities in 30 countries are accredited by ABET (ABET, 2017). Out of those 752 universities or colleges, only 99 are accredited for their associate degree programs. The United States came on the top of the list with 90 university or college followed by Saudi Arabia and Kuwait with 3 each, and Lebanon, Peru, and Singapore with 1 each. In this paper, we will reveal the fine details of all 16 ABET accredited associate degree programs in Saudi Arabia and compare them side by side. This can be used as a benchmark for similar colleges seeking ABET accreditation. The rest of this paper is structured as follows. The literature review is presented in the next section. It will be followed by data collection and study methodology. After that, a detailed study of the ABET accredited associate degree programs at YIC,

JIC, and HBCC, respectively is presented. The results and findings of the detailed study of those programs is presented after that. Finally, the paper is concluded by concluding remarks and findings.

LITERATURE REVIEW

Accreditation Bodies and Models

In north America, the Accreditation Board for Engineering and Technology (ABET) is the most popular one. We will cover it in further details in the next section. The ABET evaluate programs rather than institutions on some outcome-based criteria. It covers the different aspects of the program like students, faculty, program outcomes, and educational objectives. Some of the concerns related to ABET include: the emphasis on being put at the program level, the documentation process is stressful for the constituents, and inconsistencies between the program evaluators. In Europe, the joint declaration of the ministers of education (known as Bologna) was the first attempt to set a standard for higher education in Europe (Bologna, 2004). The quality assurance and guidelines was developed by European Association for Quality Assurance in Higher Education (ENQA) (ENQA, 2007). The major concern with the European system is the tremendous variations among the different European countries. It has been noted that some European universities are focusing on the domestic needs rather than keeping up with the industrial or continental need. In Asia, the development of quality assurance frameworks in higher education was slow. In India, they have the National Board of Accreditation (NBA). In Japan and Korea, they have Japan Accreditation Board of Engineering Education (JABEE) and Accreditation Board for Engineering Education of Korea (ABEEK), respectively. The major concern in the Asian Accreditation systems is the non-uniformity and the lack of mutual understanding and agreements. To summarize, the most common observations of the above systems or models are: 1) lack of uniformity, 2) ignoring the process cycle, 3) assessment of graduate attributes, 4) lack of global perspective.

Accreditation Board for Engineering and Technology

The Accreditation Board for Engineering and Technology (ABET) Inc., is a non-governmental non-profit organization that accredits post-secondary education programs in the fields of applied science, computing, engineering, and engineering technology (ABET, 2017, Slotkin, 2010, Bucciarelli, 2009). ABET was established in 1932 as the Engineers' Council for Professional Development (ECPD) by seven engineering societies (ABET, 2017): The American Society of Civil Engineers (ASCE), the American Institute of Mining and Metallurgical Engineers – now the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), the American Society of Mechanical Engineers (ASME), the American Institute of Electrical Engineers – now the Institute of Electrical and Electronics Engineers (IEEE), the Society for the Promotion of Engineering Education – now the American Society for Engineering Education (ASEE), the American Institute of Chemical Engineers (AIChE), and the National Council of State Boards of Engineering Examiners – now the National Council of Examiners for Engineering and Surveying (NCEES). Now It is a federation of 35 professional and technical member societies representing the fields of applied science, computing, engineering, and technology.

Programs that are accredited by ABET (formerly the Accreditation Board for Engineering and Technology) have been thoroughly evaluated and found to meet agreed-upon quality standards for the engineering profession. The organization only offers specialized accreditation for engineering, computing, technology and applied science programs; they do not accredit entire schools. ABET accreditation is voluntary; the request for accreditation is initiated by the institution seeking accreditation. Accreditation is given to individual programs within an institution rather than to the institution as a whole. Accredited programs must request re-evaluation every six years to retain accreditation; if the accreditation criteria are not satisfied, additional evaluations may be required within the six-year interval. Programs without previous accreditation can apply for accreditation as long as they have produced at least one program graduate.

ABET specifies minimum curricula for various engineering programs. For instance, ABET requires that all engineering graduates of a baccalaureate program receive at least one year of study in the natural or physical sciences and mathematics, and requires some study within general education. ABET also requires that each student complete a capstone project or design class in their education. Because of ABET's involvement, engineering curricula are somewhat standardized at the bachelor's level, thus ensuring that graduates of any ABET-accredited program have some minimal skill set for entry into the workforce or for future education. For most of its history, ABET's accreditation criteria specifically outlined the major elements that accredited engineering programs must have, including the program curricula, the faculty type, and the facilities. However, in the mid-1990s, the engineering community began to question the appropriateness of such rigid accreditation requirements. After intense discussion, in 1997, ABET adopted Engineering Criteria 2000 (EC2000). The EC2000 criteria shifted the focus away from the inputs (what material is taught) and to the outputs (what students learned). EC2000 stresses continuous improvement, and accounts for specific missions and goals of the individual institutions and programs. The intention of this approach was to enable innovation in engineering programs rather than forcing all programs to conform to a standard, as well as to encourage new assessment processes and program improvements. The first step in securing or retaining ABET accreditation is for an institution to request an evaluation of its program(s) by January 31 of the year in which accreditation is being sought. The eligibility of the institution must be established, which can be satisfied if the institution is accredited by a regional accreditation agency. Each program is then assigned to one of four accreditation commissions within ABET:

Applied Science Accreditation Commission (ASAC)
Computing Accreditation Commission (CAC)
Engineering Accreditation Commission (EAC)
Engineering Technology Accreditation Commission (ETAC)

The program is assigned to a commission based on its title (the program name shown on the transcript). Each commission has different accreditation criteria. Each program then conducts an internal evaluation and completes a self-study report. The self-study documents how well the program is meeting the established accreditation criteria in multiple areas, such as their students, curriculum, faculty, administration, facilities, and institutional support. The self-study report must be provided to ABET by July 1. While the program conducts its self-study, the appropriate ABET commission (Applied Science, Computing, Engineering, or Technology Commission) will choose a team chair to head the on-campus evaluation visit. A visit date (generally in the September – December time frame) is negotiated between the team chair and the institution. Once the date is set, the ABET commission will assign program evaluators (generally one per program being evaluated). The institution is provided the opportunity to reject the team chair or program evaluators if a conflict of interest is perceived. The team chair and evaluators are volunteers from academe, government, industry, and private practice. Once the program evaluators are accepted by the institution, they are provided with the self-study report for their assigned program. This report forms the basis of their evaluation of the program, and prepares them for the campus visit.

The evaluation team (team chair and program evaluators) will normally arrive on campus on a Saturday or Sunday. During the on-campus visit, the evaluation team will review course materials from each program, as well as student projects and sample assignments. Evaluators will also interview students, faculty, and administrators, and tour the facilities to investigate any questions raised by the self-study. The visit will normally conclude the following Tuesday with an exit interview with the institution's chief executive officer, dean, and other appropriate institution personnel as appropriate. This interview is intended to summarize the results of the evaluation for each program. Following the campus visit, the institution has 7 days in which to correct perceived errors of fact communicated during the exit interview. Following this period, the team chair will begin preparation of a draft statement to the institution; this statement undergoes extensive editing and will typically be provided to the institution several months after the visit. On receipt of the draft statement, the institution has 30 days to respond to issues identified in the evaluation. After this

response, the team chair prepares a final statement to the institution. The final statement and recommended accreditation action is reviewed by the large annual meeting of all ABET commission members in July after the campus visit. Based on the findings, the commission members vote on the final accreditation action, and the school is notified of the decision in August. The information the school receives identifies strengths, concerns, weaknesses, and deficiencies of the program, as well as recommendations for compliance with ABET criteria. Accreditation is granted for a maximum of six years, after which the institution must request another evaluation.

ABET Accredited Associate Degree Programs in Saudi Arabia

Yanbu Industrial College (YIC) (YIC, 2016), affiliated with the Royal Commission for Jubail and Yanbu (RCJY) (RCJY, 2016), is located in Yanbu Industrial City on the Red Sea coast of Saudi Arabia. YIC is the “first industrial college” in Saudi Arabia to get ABET accreditation (ABET, 2017) and has established itself, over the years, as one of the leading technical colleges in the Middle Eastern region. Six associate degree programs at YIC are accredited by the Engineering Technology Accreditation Commission (ETAC) (ABET, 2017) of ABET. The ABET accredited associate degree programs at YIC (ABET, 2017) include Electrical Power Technology (EPT), Electronics Technology (ET), Instrumentation and Control Technology (ICT), Manufacturing Technology (MT), Mechanical Maintenance Technology (MMT), and Process Operations and Chemical Analysis Technology (POCAT).

Jubail Industrial College (JIC) (JIC, 2016), also affiliated with the RCJY (RCJY, 2016), is located in Jubail Industrial City on the Arabian Gulf coast of Saudi Arabia. Hafr Al-Batin Community College (HBCC) (HBCC, 2016), affiliated with the University of Hafr Albain (UOHB), is located in Hafr AlBatin city in Saudi Arabia. Both JIC and HBCC have lately emerged among the leading technical colleges in the Middle Eastern region. The reason behind this regional recognition is due to the fact that some of the associate degree programs at both JIC and HBCC received the ABET accreditation (ABET, 2017). Having achieved this milestone, JIC becomes the “second industrial college” and HBCC becomes the “first community college” in the Kingdom of Saudi Arabia (KSA) to get ABET accreditation. Six associate degree programs at JIC and four associate degree programs at HBCC got accredited by the ETAC (ABET, 2017) of ABET. The ABET accredited associate degree programs at JIC (ABET, 2017) include Chemical Engineering Technology (CET), Electrical Power Engineering Technology (EPET), Instrumentation and Control Engineering Technology (ICET), Manufacturing Engineering Technology (MET), Mechanical Maintenance Engineering Technology (MMET), and Polymer Engineering Technology (PET). The ABET accredited associate degree programs at HBCC include Electrical and Electronics Engineering Technology (EEET), Computer Science & Engineering Technology (CSET), Mechanical Engineering Technology (MET), and Non Destructive Evaluation Technology (NDET).

DATA AND METHODOLOGY

As of December 2016, out of 50 associate degree level colleges in Saudi Arabia, only three of them are ABET accredited. Those three colleges together have 16 ABET accredited programs. All these 16 ABET accredited associate degree programs have been selected for the study. The analysis of the study was done by closely examining all the selected programs. The data were gathered from the web content of each program or through direct contact with the department administration. We have noticed that the web content of those departments were up-to-date with relatively sufficient data content. The department administration in each college will be the reference in case of variations in course classification or credit count. For simplicity, we will refer to the colleges and the programs by their official acronyms.

Yanbu Industrial College (YIC)

In this section, we briefly discuss the salient features of all the 6 ABET accredited associate degree programs at YIC. As mentioned before, the accredited programs at YIC are: Electrical Power Technology (EPT), Electronics Technology (ET), Instrumentation and Control Technology (ICT), Manufacturing Technology (MT), Mechanical Maintenance Technology (MMT), and Process Operation and Chemical Analysis Technology (POCAT). Each will be discussed briefly. The Electrical Power Technology (EPT) associate degree program at YIC consists of 26 courses totaling together 70 credit hours (YIC, 2013). The program is divided into 13 general and 13 core courses. The general courses include English Communication, English Composition, Technical Report Writing, Calculus I, Calculus II, Applied Differential Equations, General Physics, General Chemistry, Computer Programming, Industrial Safety, Industrial Supervision, Islamic Culture, and Physical Education III. The above-mentioned 13 general courses constitute for 30 credit hours (YIC, 2013). On the other hand, the core courses include Electrical and Electronics Drafting, Fundamentals of Electric Circuits, Electrical Machines I, Electronics I, Basic Industrial Electronics, Digital Electronics I, Control System Components, Power Generation & Transmission, Electrical Machines II, Electrical Control Systems, Electrical Systems and Layout, Electrical Troubleshooting and Maintenance, and Co-op Training.

Those 13 core courses constitute for 40 credit hours (YIC, 2013). The Electronics Technology (ET) associate degree program at YIC consists of 27 courses totaling together 70 credit hours. The general courses are the same as those for the EPT. The core courses include Electrical and Electronics Drafting, Fundamentals of Electric Circuits, Electrical Machines I, Electronics I, Basic Industrial Electronics, Digital Electronics I, Control System Components, PCB Fabrication, Electronics II, Digital Electronics II, Microprocessors, Communications, Electronics Troubleshooting and Maintenance, and Co-op Training. The above-mentioned 14 core courses constitute for 40 credit hours.

The Instrumentation and Control Technology (ICT) associate degree program at YIC consists of 27 courses totaling together 70 credit hours. The general courses are the same as those for ET and EPT. The core courses include Electrical and Electronics Drafting, Fundamentals of Electric Circuits, Electrical Machines I, Electronics I, Basic Industrial Electronics, Digital Electronics I, Control System Components, Process Control System I, Instrumentation Electronics, Microprocessors, Process Control System II, Analytical Instrumentation, Instrumentation Troubleshooting and Maintenance, and Co-op Training. The above-mentioned 14 core courses constitute for 40 credit hours. When comparing the core courses of EPT, ET, and ICT, we noticed the following. ICT and ET have 14 core courses compared to only 13 for EPT. Moreover, the following 7 courses are exactly the same for the three programs: Electrical and Electronics Drafting, Fundamentals of Electric Circuits, Electrical Machines I, Electronics I, Basic Industrial Electronics, Digital Electronics I, and Control System Components. In addition, ICT and ET share another similarity which the Microprocessors course.

The Manufacturing Technology (MT) associate degree program at YIC consists of 28 courses totaling together 70 credit hours. The general courses include English Communication, English Composition, Technical Report Writing, Calculus I, Calculus II, General Physics, General Chemistry, Computer Programming, Industrial Safety, Industrial Supervision, Islamic Culture, and Physical Education III. The above mentioned 12 general courses constitute for 28 credit hours. The core courses for the MT include Engineering Drafting, Applied Mechanics, Mechanical Measurements, Machining Processes I, Materials Technology, Plant Maintenance, Applied Statistics, Industrial Electricity, Mechanical Drafting, Machining Processes II, Applied Strength of Materials, CAD/CAM Technology, Inspection and Quality Control, Machine Tool Design, Elective, and Co-op Training. The above-mentioned 16 core courses constitute for 42 credit hours. The elective courses for the MT include Welding Technology and Sheet Metal Technology.

The Mechanical Maintenance Technology (MMT) program consists of 27 courses totaling together 70 credit hours. The general courses for the MMT are the same as those for the MT program at YIC. The core courses for the MMT include Engineering Drafting, Applied Mechanics, Mechanical Measurements, Machining Processes I, Materials Technology, Plant Maintenance, Applied Statistics, Industrial Electricity, Mechanical Drafting, Applied Thermodynamics, Fluid Machines, Equipment Maintenance, Heat Exchangers, Elective, and Co-op Training. The abovementioned 15 core courses constitute for 42 credit hours. Nine of the MMT core courses are exactly the same as those for the MT program, namely, Engineering Drafting, Applied Mechanics, Mechanical Measurements, Machining Processes I, Materials Technology, Plant Maintenance, Applied Statistics, Industrial Electricity, and Mechanical Drafting. The elective courses for the MMT include Refrigeration and Air Conditioning Technology and Hydraulics and Pneumatics Technology. The Process Operation and Chemical Analysis Technology (POCAT) associate degree program at YIC consists of 26 courses totaling together 70 credit hours. The general courses for the POCAT program are the same as those for the MT and MMT program. The only difference among the general requirements for the MT, MMT, and POCAT when compared to the EPT, ET, and ICT is the presence of Applied Differential Equations course in the EPT, ET, and ICT associate degree programs. The core courses for the POCAT include Engineering Drafting, Introduction to Chemical Engineering Technology, Fluid Mechanics, Methods of Chemical Analysis, Applied Organic Chemistry, Process Heat Transfer, Chemical Engineering Thermodynamics, Mass Transfer Operations, Petroleum Refining & Testing, Applied Statistics, Environmental Pollution, Process Instrumentation & Control, Petrochemicals, and Co-op Training. The above-mentioned 14 core courses constitute for 42 credit hours. Only two POCAT core courses are exactly the same as those for the MT and MMT namely, Engineering Drafting and Applied Statistics.

Jubail Industrial College (JIC)

In this section, we briefly discuss the salient features of all the 6 ABET accredited associate degree programs at JIC. The accredited programs at JIC are Chemical Engineering Technology (CET), Electrical Power Engineering Technology (EPET), Instrumentation and Control Engineering Technology (ICET), Manufacturing Engineering Technology (MET), Mechanical Maintenance Engineering Technology (MMET), and Polymer Engineering Technology (PET). Each will be discussed briefly.

The Chemical Engineering Technology (CET) associate degree program at JIC consists of 29 courses totaling together 72 credit hours (JIC, 2014). The general courses include English III, English IV, Technical Writing, Calculus I, Fundamentals of Physics, General Chemistry, Computer Applications, Engineering Drawing, Workshop Technology, Industrial Safety and Environment, Islamic Culture, and Organizational Behavior and Ethics. The above-mentioned 12 general courses constitute for 27 credit hours (JIC, 2014). The core courses include Organic Chemistry I, Chemical Engineering Principles, Process Equipment, Instrumentation and Process Control, Computer Applications in Chemical Engineering, Industrial Chemical Processes, Transport Processes, Reaction Kinetics and Reactors, Chemical Engineering Thermodynamics I, Process Plant Safety, Petroleum Refining Technology, Separation Processes I, Process Plant Simulation, Environmental Control, Elective, Project, and Coop Training. The above-mentioned 17 core courses constitute for 45 credit hours (JIC, 2014).

The Electrical Power Engineering Technology (EPET) program consists of 27 courses totaling together 72 credit hours. The general courses include English III, English IV, Technical Writing, Calculus I, Fundamentals of Physics, General Chemistry, Computer Applications, Workshop Technology, Industrial Safety and Environment, Islamic Culture, and Organizational Behavior and Ethics. The abovementioned 11 general courses constitute for 26 credit hours. The only difference between the general courses for EPET and CET is the presence of Engineering Drawing course in the CET associate degree program. The core courses for the EPET include Electrical Circuits I, Instrumentation and Measurements I, Electrical Machines I, Electrical Circuits II, Electronics, Electrical Machines II,

Electrical Control and Protection I, Power Electronics, Electrical Wiring, Power Plant Operation, Transmission and Distribution of Electrical Energy, Electrical Troubleshooting, Programmable Logic Controllers, Elective, Project, and Co-op Training. The above-mentioned 16 core courses constitute for 46 credit hours. The Instrumentation and Control Engineering Technology (ICET) program at JIC consists of 28 courses totaling together 72 credit hours. The general courses for ICET are the same as those for the CET associate degree program. The core courses include Electrical Circuits I, Instrumentation and Measurements I, Process Equipment, Analogue Electronics, Digital Electronics, Instrumentation and Measurements II, Electrical Machines and Controls, Industrial Control, Introduction to Microprocessor, Instrumentation System Diagram, Instrumentation Engineering, Computer Control I, Programmable Logic Controllers, Elective, Project, and Coop Training. The above-mentioned 16 core courses constitute for 45 credit hours. Out of those 16 core courses only the Process Equipment course is common with CET. On the other hand, Electrical Circuits I, Instrumentation and Measurements I, and Programmable Logic Controllers courses are common with EPET.

The Manufacturing Engineering Technology (MET) associate degree program at JIC consists of 30 courses totaling together 72 credit hours. The general courses are the same as those for the CET. The core courses for the MET include Manufacturing Processes I, Introduction to Engineering Materials, Manufacturing Processes II, Production Technical Drawing, Plant Maintenance, Applied Mechanics, Strength of Materials, Metallurgy, Mechanical CAD Applications, Manufacturing Processes III, Metrology and Quality Control, Electrical and Electronic Principles, Machine Elements, Production Planning and Control, Welding and Inspection, Elective, Project, and Co-op Training. The above-mentioned 18 core courses constitute for 45 credit hours. The Mechanical Maintenance Engineering Technology (MMET) associate degree program at JIC consist of 29 courses totaling together 72 credit hours. The general courses are the same as those for the CET and MET. The core courses for the MMET include Plant Maintenance, Introduction to Engineering Materials, Fluid Mechanics, Computer Aided Drafting, Applied Mechanics, Electrical Circuits I, Strength of Materials, Applied Thermodynamics, Metrology and Quality Control, Pumping Machinery and Installations, Electrical Machines and Controls, Hydraulics and Pneumatics, Industrial Compressors, Power Generation Systems, Elective, Project, and Co-op Training. The above-mentioned 17 core courses constitute for 45 credit hours. Only Electrical Circuits I course is common between MMET and EPET. On the other hand, Electrical Circuits I and Electrical Machines and Controls courses are common among MMET and ICET. Also when comparing MMET with MET we found the following 5 common core courses: Introduction to Engineering Materials, Plant Maintenance, Applied Mechanics, Strength of Materials, and Metrology and Quality Control.

The Polymer Engineering Technology (PET) associate degree program at JIC consists of 27 courses totaling together 72 credit hours. The general courses include English III, English IV, Technical Writing, Calculus I, Fundamentals of Physics, General Chemistry, Computer Applications, Engineering Drawing, Industrial Safety and Environment, Islamic Culture, and Organizational Behavior and Ethics. The above mentioned 11 general courses constitute for 26 credit hours. The only difference among the general requirements for the PET and those for the CET, ICET, MET, and MMET is the presence of Workshop Technology course in the CET, ICET, MET, and MMET. The difference between the general requirements for the PET with those for the EPET is the presence of Engineering Drawing course in the PET and the presence of Workshop Technology course in the EPET. The core courses for PET include Introduction to Polymer Technology, Process Equipment, Polymer Science and Engineering, Polymer Chemistry, Instrumentation and Process Control, Polymer Materials, Industrial Polymerization, Polymer Characterization and Testing, Polymer Processing I, Quality Control, Polymer Processing II, Polymer Engineering and Design, Process Plant Simulation, Elective, Project, and Co-op Training. The above-mentioned 16 core courses constitute for 46 credit hours. The Process Equipment, Instrumentation and Process Control, and Process Plant Simulation courses are common between PET and CET. *The Process Equipment course is common between PET and ICET. Moreover, the elective courses for all the 6 ABET accredited associate degree programs at JIC*

include Management Theory and Practice, Principles of Marketing, Principles of Economics, Soft Skills, Management Information System, Business English Correspondence, and Enterprise Resource Planning.

Hafr Albatin Community College (HBCC)

In this section, we briefly discuss the salient features of all the 4 ABET accredited associate degree programs at HBCC. The accredited programs at HBCC are Electrical and Electronics Engineering Technology (EEET), Computer Science and Engineering Technology (CSET), Mechanical Engineering Technology (MET), and Non-Destructive Evaluation Technology (NDET). Each will be discussed briefly. Electrical and Electronics Engineering Technology (EEET) associate degree program at HBCC consists of 20 courses together totaling 64 credit hours (HBCC, 2009). The general courses for the EEET include English Composition I, English Composition II, Applied Calculus, General Physics, Computer Programming, Industrial Safety, Islamic Ideology, and Objective Writing. The abovementioned 8 general courses constitute for 22 credit hours (HBCC, 2009). The core courses for this program include Electric Circuits, Digital Circuits I, Electronic Workshop, Solid State Devices, Digital Circuits II, Electronic Circuits, Electronic Troubleshooting, Instrumentation and Measurements I, Elective I, Elective II, Elective III, and Co-op Training. The abovementioned 12 core courses constitute for 42 credit hours (HBCC, 2009). Moreover, the elective courses include Industrial Electronics, Microprocessor Interfacing, Programmable Logic Controllers, and Microcontroller Applications (HBCC, 2009).

Computer Science and Engineering Technology (CSET) associate degree program at HBCC consists of 18 courses together totaling 64 credit hours. The general courses for CSET consist 7 courses totaling together 21 credit hours and they are the same as for EEET excluding the Industrial Safety course. The core courses for the CSET program include Visual Programming I, Computer Organization, Database Applications, Solid State Devices, System Analysis & Design, Visual Programming II, Computer Networking, PC Operating Systems, PC Maintenance & Troubleshooting, Internet Services & Web Authoring, and Co-op Training. The abovementioned 11 core courses constitute for 43 credit hours. Only Solid State Devices core course is common between CSET and EEET.

Mechanical Engineering Technology (MET) associate degree program at HBCC consists of 20 courses together totaling 64 credit hours. The general courses include English Composition I, English Composition II, Applied Calculus, General Physics, Computer Programming, Applied Electricity & Electronics, Industrial Safety, Islamic Ideology, and Objective Writing. The abovementioned 9 general courses constitute for 25 credit hours. When comparing the general courses for both MET and EEET, we note presence of Applied Electricity & Electronics course in the MET when it is not there in EEET. When comparing the general course for both MET and CSET, we note the presence of Applied Electricity & Electronics and Industrial Safety courses in the MET when it is not there in CSET. The core courses for MET include Technical Drafting, Applied Mechanics, Applied Thermo-Fluids, Materials Science and Technology, Thermal System Performance, Industrial Hydraulics & Pneumatics, Welding & Forming, Machining, Automotive Technology, Troubleshooting & Maintenance, and Co-op Training. The abovementioned 11 core courses constitute for 39 credit hours.

Non Destructive Evaluation Technology (NDET) associate degree program at HBCC consists of 23 courses together totaling 70 credit hours. The general courses include English Composition I, English Composition II, Applied Calculus, General Physics, Computer Programming, Applied Electricity & Electronics, Islamic Ideology, and Objective Writing. The above-mentioned 8 general courses constitute for 24 credit hours. When comparing the general courses for both NDET and EEET, we note the presence of Applied Electricity & Electronics course in the NDET when it is not there in EEET. On the other hand, we note the presence of the Industrial Safety course in EEET when it is not there in NDET. When comparing the general requirements for NDET with those for CSET, the Applied Electricity & Electronics course is there in NDET

where it is not there in CSET. Moreover, when comparing the general requirements for NDET with those for MET, the Industrial Safety course is there in MET where it is not there in NDET.

The core courses for NDET include Technical Drafting, Introduction to Non Destructive Testing, Radiation Safety, Materials Science and Technology, Practical Sessions for Ultrasonic Testing, Instrumentation and Measurements I, Visual Testing I & II, Ultrasonic Testing I & II, Welding & Machining, Practical Sessions for Radiographic Testing & Ultrasonic Testing, Radiographic Testing I & II, Liquid Penetrant Testing I & II, Magnetic Particle Testing I & II, Inspection Codes & Practices, and Co-op Training. The abovementioned 15 core courses constitute for 46 credit hours. Only Instrumentation and Measurements I core course is common between NDET and EEET. Moreover, Technical Drafting and Materials Science and Technology core courses are common between NDET and MET.

RESULTS

Table 1 shows a comparison of all the ABET accredited associate degree programs at YIC, JIC, and HBCC in terms of the number of courses. As can be seen from the table, the CSET associate degree program at HBCC require the least number of courses (18 courses), whereas the MAET associate degree program at JIC requires most number of courses (30 courses).

Table 1: General and Core Courses

Program	General	Core	Total
EPT	13	13	26
ET	13	14	27
ICT	13	14	27
MT	12	16	28
MMT	12	15	27
POCAT	12	14	26
CET	12	17	29
EPET	11	16	27
ICET	12	16	28
MET	12	18	30
MMET	12	17	29
PET	11	16	27
EEET	8	12	20
CSET	7	11	18
MET	9	11	20
NDET	8	15	23

This table compares the required number of general and core courses in ABET accredited associate degree program at yanbu industrial college, jubail industrial college, and hafr albatin community college.

Tables 2 and 3 compares the theoretical and the practical general and core requirements for all the programs in the three colleges in terms of contact hours per week respectively. For all the programs, the co-op students are required to spend 40 hours per week (8 hours per day for 5 working days) during their training period. Therefore, when calculating the lab hours, those 40 training hours where included.

Table 2: Lecture vs. Lab Hours for General Courses

Program	Lect. H/Week	Lab H/Week	Total H/Week
EPT	25	13	38
ET	25	13	38
ICT	25	13	38
MT	23	13	36
MMT	23	13	36
POCAT	23	13	36
CET	18	26	44
EPET	18	24	42
ICET	18	26	44
MET	18	26	44
MMET	18	26	44
PET	18	24	42
EEET	19	8	27
CSET	18	8	26
MET	21	11	32
NDET	20	11	31

This table compares the theoretical and practical requirements in terms of contact hours for the general courses in and core courses in ABET accredited associate degree program at yanbu industrial college, jubail industrial college, and hafr albatin community college.

Table 3: Lecture vs. Lab Hours for Core Courses

Program	Lect. H/Week	Lab H/Week	Total H/Week
EPT	24	79	103
ET	23	82	105
ICT	23	82	105
MT	24	85	109
MMT	25	82	107
POCAT	27	76	103
CET	28-29	74-76	102-105
EPET	28-29	80-82	108-111
ICET	26-27	82-84	108-111
MET	24-25	84-86	108-111
MMET	26-27	77-79	103-106
PET	29-30	74-76	103-106
EEET	22-23	79-82	101-105
CSET	22	73	95
MET	22	73	95
NDET	25	85	110

This table compares the theoretical and practical requirements in terms of contact hours for the core courses in and core courses in ABET accredited associate degree program at yanbu industrial college, jubail industrial college, and hafr albatin community college.

Table 4 shows the required number of credit hours in ABET accredited associate degree programs at YIC, JIC, and HBCC. As it can be seen from this table, all the ABET accredited associate degree programs at YIC and JIC have a uniform total credit hours of 70 and 72, respectively.

Table 4: Credit Hours Comparison

Program	General Credit H	Core Credit H	Total Credit H
EPT	30	40	70
ET	30	40	70
ICT	30	40	70
MT	28	42	70
MMT	28	42	70
POCAT	28	42	70
CET	27	45	72
EPET	26	46	72
ICET	27	45	72
MET	27	45	72
MMET	27	45	72
PET	26	46	72
EEET	22	42	64
CSET	21	43	64
MET	25	39	64
NDET	24	46	70

This table compares the total credit hours for the ABET accredited associate degree program at yanbu industrial college, jubail industrial college, and hafir albatin community college.

As per the ABET General Criterion 5: Curriculum for accrediting engineering technology programs state that the technical content of the program must represent at least 1/3rd of the total credit hours for the program but no more than 2/3rd of the total credit hours for the program (ABET, 2017). In Table 5, the credit hours the technical content in ABET accredited associate degree programs at YIC, JIC, and HBCC is examined closely. It can be seen from the table that all the ABET accredited associate degree programs at YIC, JIC, and HBCC satisfy this criterion.

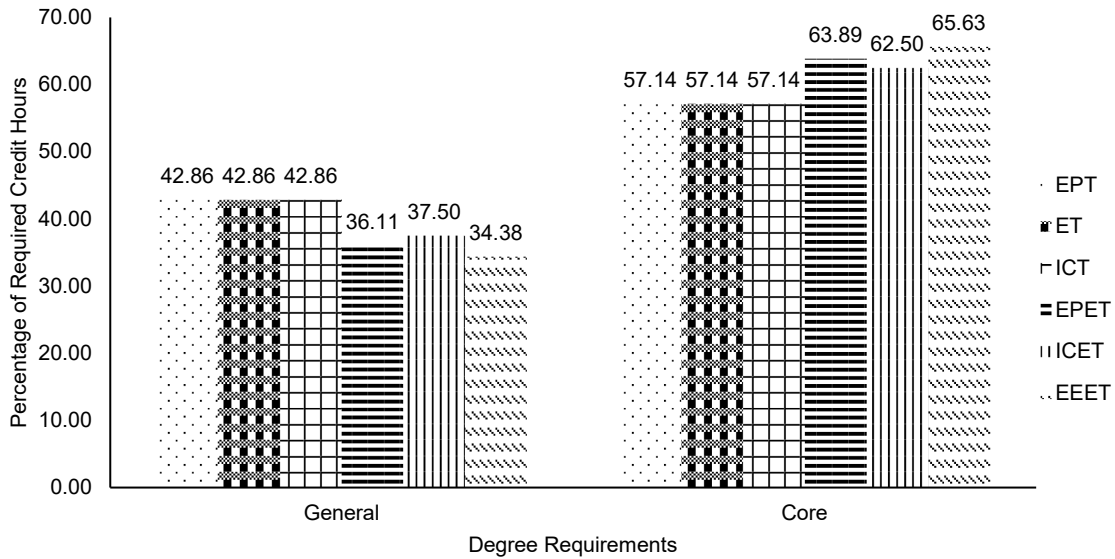
Table 5: Technical Content Credit Hours

Program	Total Credit H	1/3 rd	2/3 rd	Core Credit H
EPT	70	23	47	40
ET	70	23	47	40
ICT	70	23	47	40
MT	70	23	47	42
MMT	70	23	47	42
POCAT	70	23	47	42
CET	72	24	48	45
EPET	72	24	48	46
ICET	72	24	48	45
MET	72	24	48	45
MMET	72	24	48	45
PET	72	24	48	46
EEET	64	21	43	42
CSET	64	21	43	43
MET	64	21	43	39
NDET	70	23	47	46

This table compares the technical content credit hours in ABET accredited associate degree program at yanbu industrial college, jubail industrial college, and hafir albatin community college.

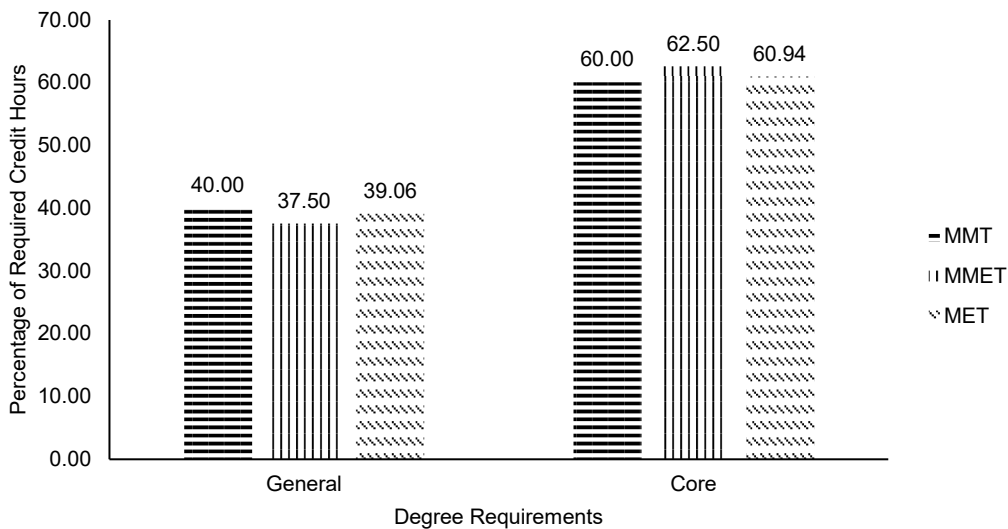
Figures 1 through 7 show the percentage of required credit hours in ABET accredited associate degree programs at YIC, JIC, and HBCC. In Figures 1 through 4, the percentage of required credit hours for similar programs (same field of study) are compared with each other, whereas the percentage of required credit hours for non-similar programs are shown separately in Figures 5 through 7.

Figure 1: EPT, ET, ICT, EPET, ICET, and EEET



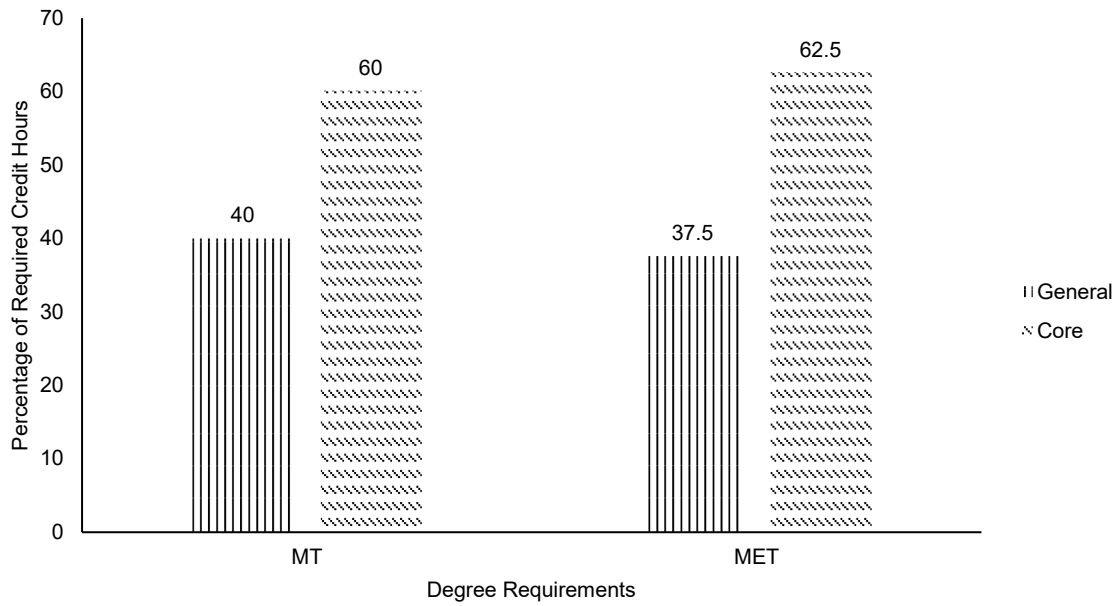
This figure compares the percentage of required credit hours in EPT, ET, ICT, EPET, ICET, and EEET associate degree programs at yanbu industrial college, jubail industrial college, and hafr albatin community college.

Figure 2: MMT, MMET, and MET



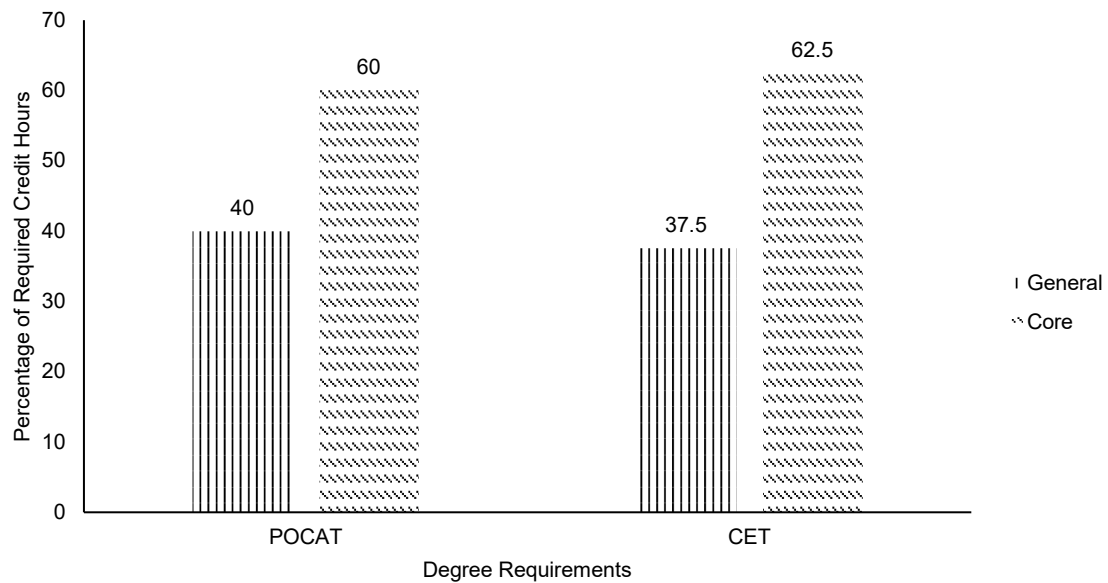
This figure compares the percentage of required credit hours in MMT, MMET, and MET associate degree programs at yanbu industrial college, jubail industrial college, and hafr albatin community college.

Figure 3: MT, and MET



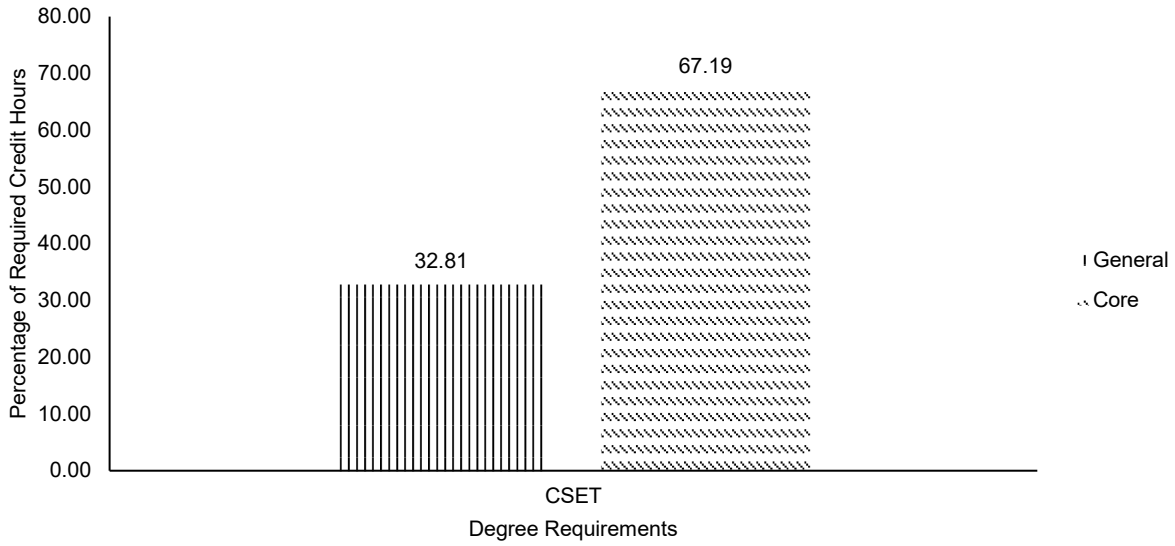
This figure compares the percentage of required credit hours in MT and MET associate degree programs at yanbu industrial college, and jubail industrial college.

Figure 4: POCAT and CET



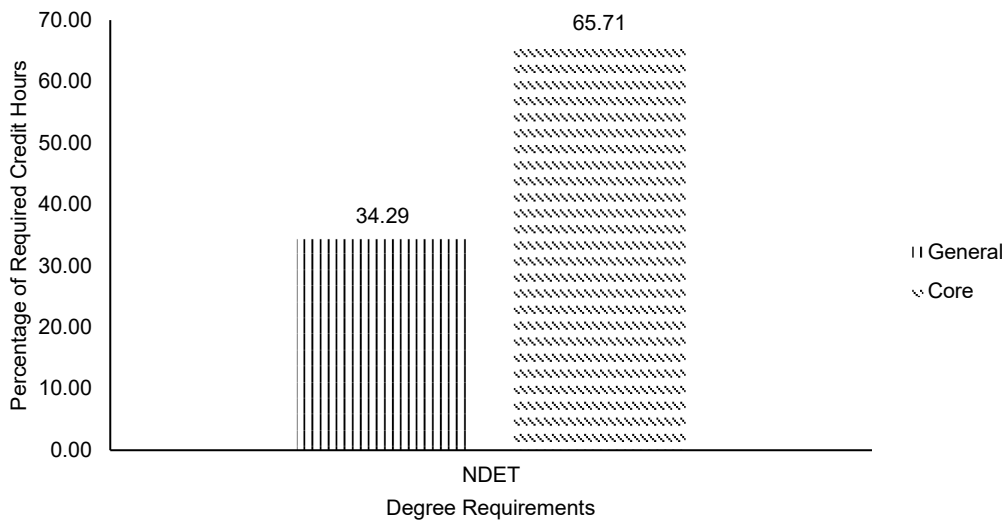
This figure compares the percentage of required credit hours in POCAT and CET associate degree programs at yanbu industrial college, and jubail industrial college.

Figure 5: CSET



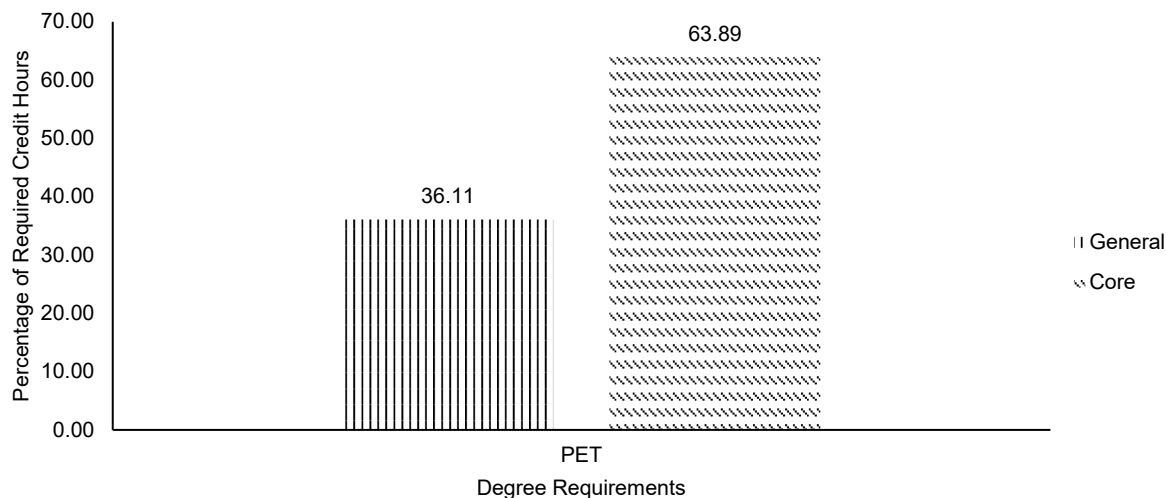
This figure shows the percentage of required credit hours in CSET associate degree program at hafr albatin community college.

Figure 6: NDET



This figure shows the percentage of required credit hours in NDET associate degree program at hafr albatin community college.

Figure 7: PET



This figure shows the percentage of required credit hours in PET associate degree program at jubail industrial college.

CONCLUDING COMMENTS

Upon careful study and analysis of those programs, the following conclusions can be drawn: 1). 50% of the core requirements for both ET and EPT at YIC are the same, 2). when comparing ICT, EPT, and ET at YIC, they are 50% and 57.14% the same respectively, 3). the core requirements for MMT and MT at YIC are 60% the same, 4). the core requirements for POCAT is only 14.29% similar when compared to those for MT and MMT at YIC, 5). when comparing ICET, CET, and EPET at JIC, they are 6.25% and 18.75% the same respectively, 6). when comparing MMET, EPET, ICET, and MET at JIC, they are 5.88%, 11.76%, and 29.41% the same respectively, 7).

When comparing PET, CET, and ICET at JIC, they are 18.75% and 6.25% the same respectively, 8). 9.09% of the core requirements for both CSET and EEET at HBCC are the same, 9). when comparing NDET, EEET, and MET at HBCC, they are 6.67% and 13.33% the same respectively, and 10). all the ABET accredited associate degree programs at YIC and JIC have a uniform total credit hours of 70 and 72, respectively. Therefore, we propose to increase the total credit hours of the EEET, CSET, and MET associate degree programs at HBCC from 64 to 70 like NDET. This can be achieved by introducing new design or elective courses. The number of credit hours for the co-op training course in all the ABET accredited associate degree programs at YIC and JIC is 3. Therefore, we propose to reduce the number of credit hours for the co-op training from 6 to 3 in all the ABET accredited associate degree programs at HBCC.

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