Depth and Breadth of Mathematics Syllabus for Engineering Technology Students in UniversitiTun Hussein Onn Malaysia

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Abstract

The Faculty of Engineering Technology (FTK), University Tun Hussein Malaysia (UTHM) is currently developing the Engineering Technology program. Note that there are differences between classical engineering as compared toengineering technology program. In particular, the curriculum of both program has to be different. According to Accreditation Board for Engineering and Technology (ABET),Engineering programs often focus on theory and conceptual design, while engineering technology programs usually focus on application and implementation. In addition, Engineering programs require additional, higher-level mathematics, including multiple semesters of calculus and calculus-based theoretical science courses. Meanwhile, engineering technology programs typically focus on algebra, trigonometry, applied calculus, and other courses that are more practical than theoretical in nature.Here, the study is carried out to investigate the depth and breadth of mathematics syllabus taught by the FTK in UTHM.An online survey has been conducted. The respondents are engineers who are currently working all over Malaysia. The respondents are required to scale from the most significant to the least significant of 18 different topics of mathematics that related to their working environment. The results show that the majority of respondents agree to maintain the chapters taught in the classproposed by the FTK. However, some topics are not related to the industries can be eliminated from the syllabus.

Keywords: Mathematics Syllabus, Engineering Technology, Conventional Engineering, Industries View, ABET.

Introduction

Various studies have shown that mathematics is an important subject used in industries[1]–[3].In general, themajority of industrial engineers agree that the common core of mathematics subjects isrelevant and required by industries[4].However, the depth and breadth of the mathematic subject require further investigation and discussion particularly from the current industrial view. Can mathematics taught in class provide sufficient knowledge for the students when they are working in industrial areas?Moreover, how strong bond between these industries and universities can be improved? It has been reported that mathematics is"the key academic hurdle" in the supply of engineering graduates [5]–[7]. This is indeed affect to the engineering technology students.

Mathematics is one of the oldest and most elemental sciences in the world. According to [8], mathematics is used widely in a range of professions such as to design better climate models, improves the accuracy of soil analysis, makes chemical content analysis for fertilizer more accurate and etc. Moreover, [9] has discussed the importance of mathematics in manufacturing or in industrial engineering.However, it is of particular importance in the field of industry and manufacturing. [8] has further discussed that mathematicians fall into two broad categories; theoretical or pure mathematics and applied mathematics. Interesting fact from ABET [10] shows that the conventional engineering of undergraduate programs include more mathematics work and require a highermathematical level than the Engineering Technology programs. This is mainly due to the fact that the engineering undergraduate programs often focus on theory, while engineering technology programs usually focus on application.

Note that, the FTK is the newly developed faculty in UTHM that produces a technologist[11].The FTK is responsible to distinguish the engineering technology students as compared to the conventional engineering students. The nature of the work of an engineering technologist is usually focused on the portion of the technological spectrum closest to product improvement, manufacturing, construction, and engineering operational functions[12].However, technologists often work with engineers in a wide variety of projects by applying basic engineering principles and technical skills. This can be a very challenging task for FTK since their industrial tasks of both engineers and technologist are very closed. Hence, how the depth and breadth of mathematics subjects taught to the technologist related to their work in industries can be one of the solution to resolve the difference issue between engineering technology and engineering program.

Research Objectives

The objectives of the research are

1. To investigate the depth and breadth of mathematics syllabus taught by FTK in UTHM.

2. To improve the mathematics syllabuses that required by industries.

Method of Research

An online survey has been conducted and disseminated to various industries in Malaysia. The target respondents for this research are engineers from industries who expert in electrical engineering. The engineers are ranging from different ages, numerous and di- verse language, nationality and cultural background. Likert scale with the range of 1 to 5 (strongly agree to strongly disagree) is used for each question.

Data Analysis

In this survey, 18 different topics of mathematics taught in FTK were included. The topics are differential and applications, limit and continuity, vector, introduction to differential equation, first order differential, second order linear differential equation, Laplace transform, numerical solution of differential equation, function of several variables, multiple integration, non-linear equations, system of linear equation, interpolation, numerical differentiation, eigen values, differentiation and applications, partial differential equation, and integration.

4.1 Industries Profile

Table 1 shows the tabulation of respondents from 32companies.Based on Table 1, the majority of respondents comes from Other Industries such as agriculture, logistics and aircraft with the number of respondents is 10.

Table 1: Distribution of respondent by types of industry

Types of industry	Number
Electrical & Electronic company	8
Mechanical company	3
Industrial Automation company	8
Construction company	1
Chemical company	2
Others	10
TOTAL	32

4.2 Results and Discussion

The overall results show that 58% of respondents agree (i.e. agree and disagree) that mathematics topics taught by FTK are really useful in industries. Meanwhile, only 11 % of respondents disagree (i.e. disagree and strongly disagree). However, about 31% of respondents are not sure (i.e. neutral) of some topics whether it should be taught or not. Details results are discussed next.

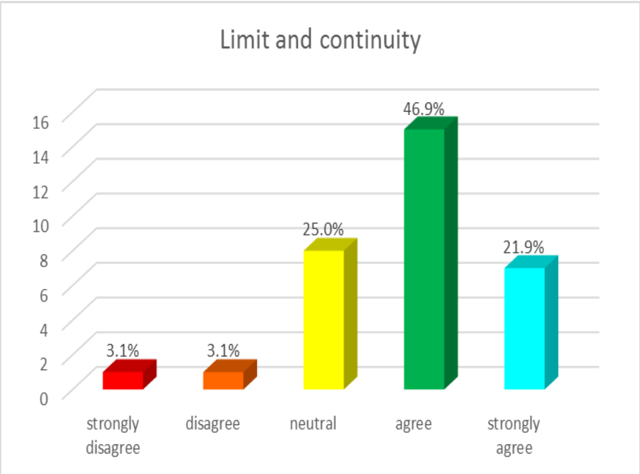

Figure 1: Requirements on topic limit and continuity.

Figure 1 shows the highest percentage (46.9%) of respondents agree that limit and continuity are used in industry. The lowest percentage is (3.1%) which least respondent strongly disagrees and disagree. The rest of them were neutral with a percentage of (25.0%) and strongly agree (21.9%).

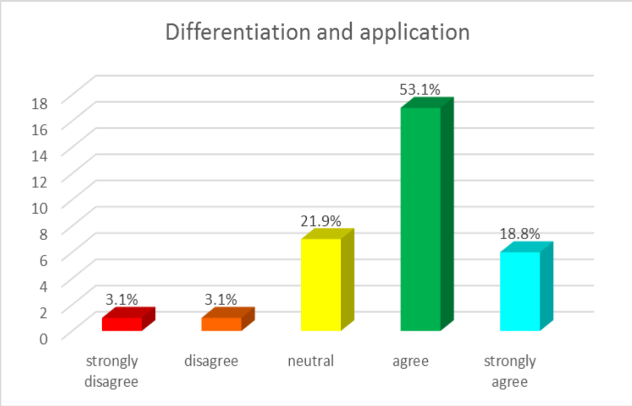

Figure 2: Requirements on topic differentiation and application.

Figure 2 shows the highest percentage (53.1%) of respondents agree that differentiation and applicationare used in industry. The lowest percentage is (3.1%) which least respondent strongly disagrees and disagree. The rest of them are neutral with a percentage of (21.9%) and strongly agree (18.8%).

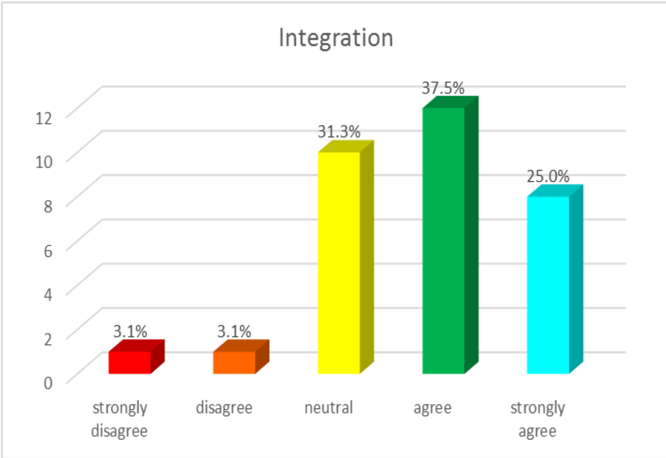

Figure 3: Requirements on topic integration.

Figure 3 shows the highest percentage (37.5%) of respondents agree that integrationis usedin industry. The lowest percentage is (3.1%) which least respondent strongly agree and disagree. The rest of them are neutral with a percentage of (31.3%) and strongly agree (25.0%).

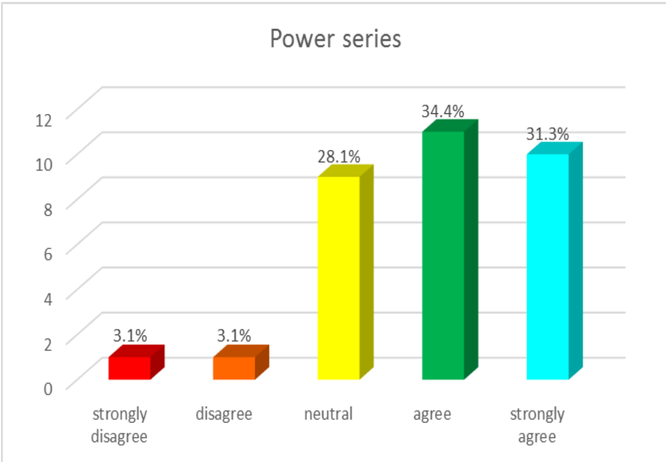

Figure 4: Requirements on topicpower series.

Figure 4 shows the highest percentages (34.4%) of respondents agree that power series are used in industry. The lowest percentage is (3.1%) which least respondent strongly disagrees and disagree on the topic. The rest of them are neutral with a percentage of (28.1%) and strongly agree (31.3%).

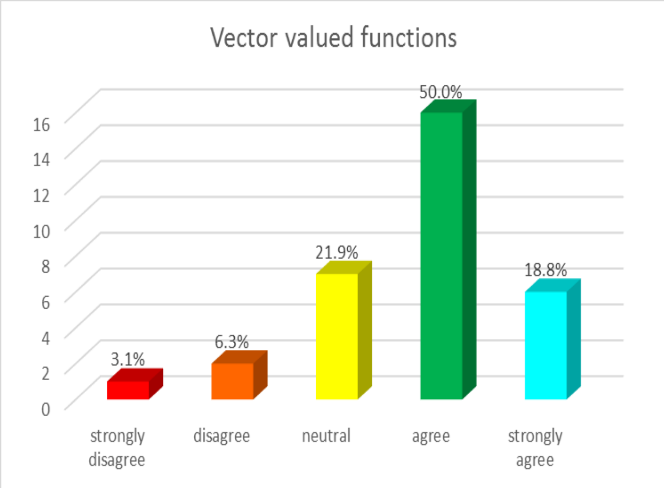

Figure 5: Requirements on topic value vector functions.

Figure 5 shows the highest percentage (50.0%) of respondents agree that value vector functions are used in industry. The lowest percentage is (3.1%) which least respondent strongly disagrees and (6.3%) disagree on the topic. The rest of them are neutral with a percentage of (21.9%) and strongly agree (18.8%).

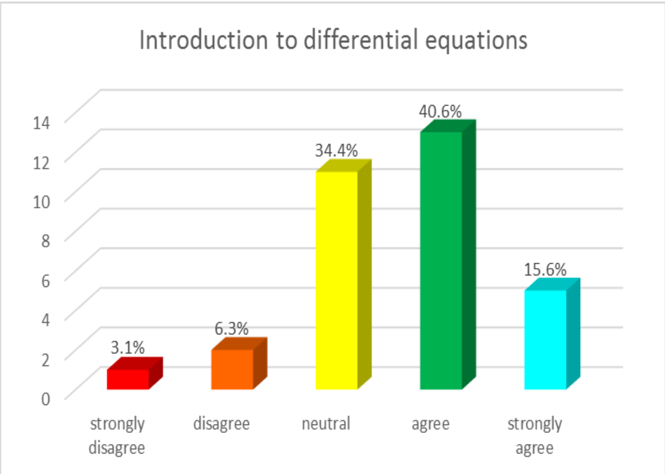

Figure 6: Requirements on topic introduction to differential equations.

Figure 6 shows the highest percentage (40.6%) of respondents agree that introduction to the differential equation is used in industry. The lowest percentage is (3.1%) which least respondents strongly disagree and (6.3%) disagree on the topic. The rest of them are neutral with a percentage of (34.4%) and strongly agree (15.6%).

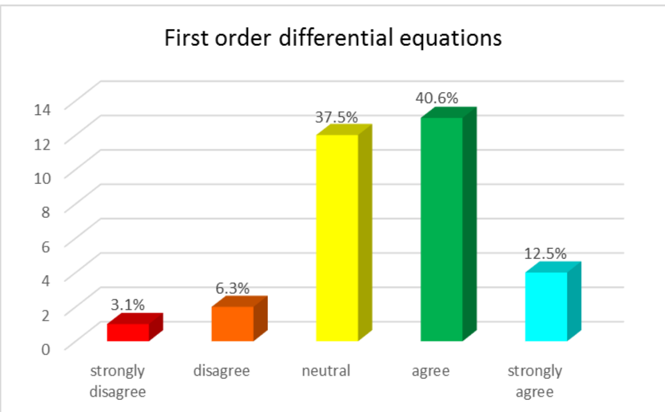

Figure 7: Requirements on topic first order differential equations.

Figure 7 shows the highest percentage (40.6%) of respondents agree that first order differential equations currently is used in industry. The lowest percentage is (3.1%) which least respondent strongly disagrees and (6.3%) disagree on the frequency of this topic. The rest of them were neutral with a percentage of (37.5%) and strongly agree (12.5%).

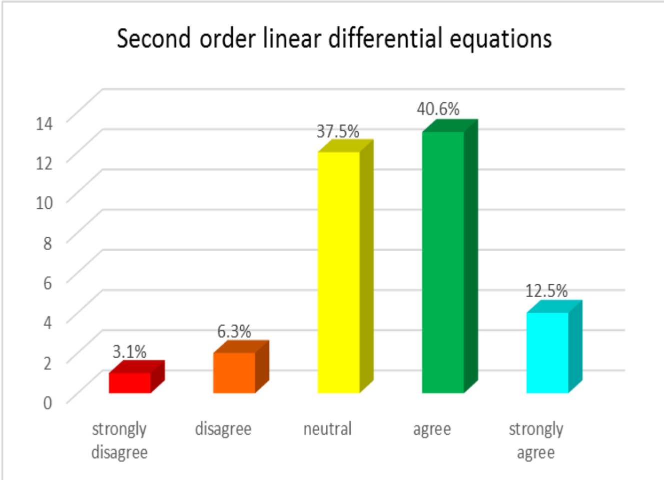

Figure 8: Requirements on topic second order linear differential equations.

Figure 8 shows the highest percentage (40.6%) of respondent agree that second order linear differential equations are used in industry. The lowest percentage is (3.1%) which least respondent strongly disagrees and (6.3%) disagree on the topic. The rest of them were neutral with a percentage of (37.5%) and strongly agree (12.5%).

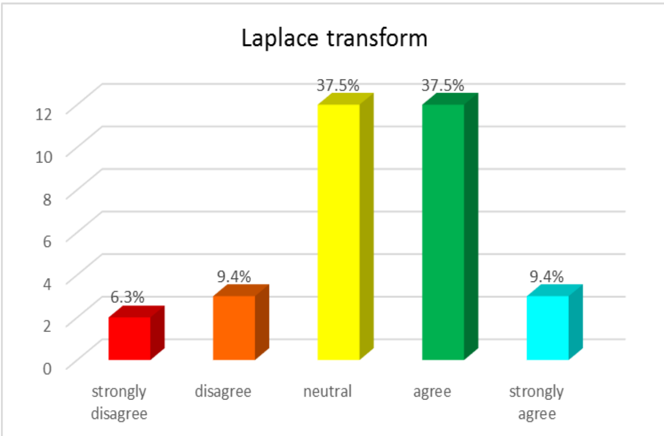

Figure 9: Requirements on topic laplace transform.

Figure 9 shows the highest percentage(37.5%) of respondents are neutral and agree that the Laplace transform is usedin industry. The lowest percentage is (6.3%) which least respondents strongly disagree.Similar percentage (9.4%) of respondents disagree and strongly on the topic.

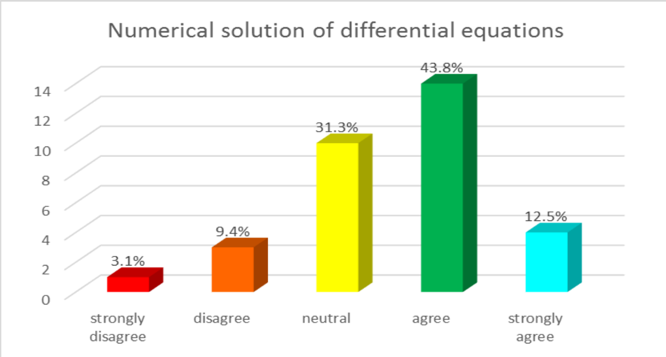

Figure 10: Requirements on topicnumerical solution.

Figure 10 shows the highest percentage (43.8%) of respondent agree and the second highest (31.3%) of respondents neutral that numerical solution is used in industry. The lowest percentage is (3.1%) which the least respondents strongly disagree and (9.4%) disagree on the topic. The rest of them were strongly agreed with a percentage of (12.5%).

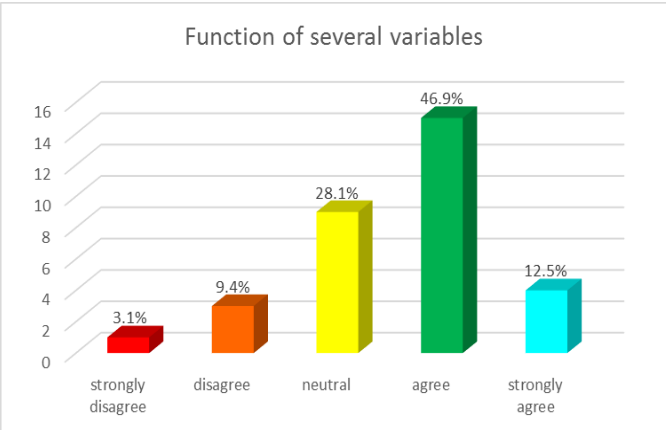

Figure 11: Requirements on topic function of several variables.

Figure 11 shows the highest percentage (46.9%) of respondent agree and (28.1%) neutral that function of several variables is used in industry. The lowest percentage is (3.1%) which the least respondents strongly disagree and (9.4%) disagree. The rest of them were strongly agreed with percentage (12.5%).

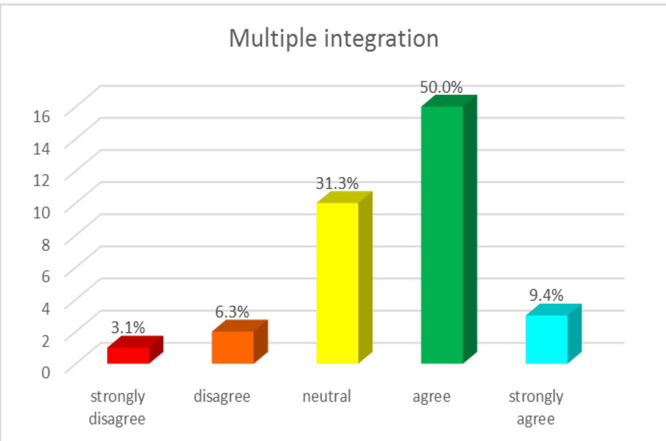

Figure 12: Requirements on topic multiple integration.

Figure 12 shows the highest percentage (50.0%) of respondents agree and (31.3%) neutral that multiple integration is used in industry. The lowest percentage is (3.1%) which least respondents strongly disagree and (6.3%) disagree on the topic. The rest of them were strongly agreed with percentage (9.4%).

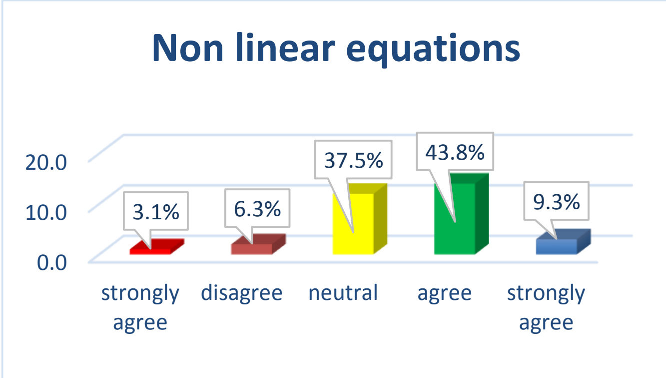

Figure 13: Requirements on topic non-linear equations.

Figure 13 shows the highest percentage (43.8%) of respondents agree and (37.5%) neutral that non-linear equations are used in industry. The lowest percentage (i.e. 3.1%) which least respondents strongly disagree and strongly agree on the topic. The rest of them disagree with the percentage (6.3%) and strongly disagree (9.3%).

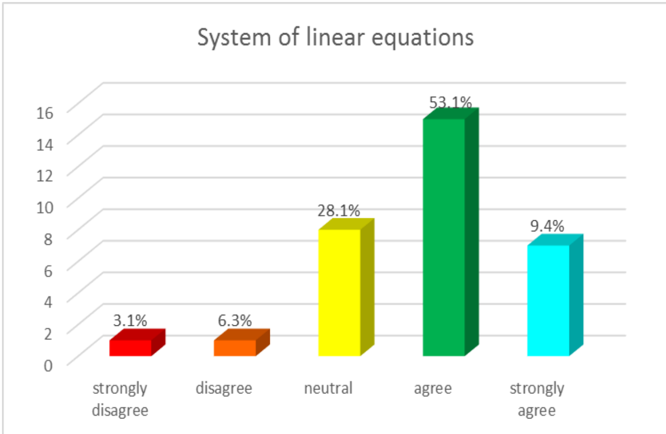

Figure 14: Requirements on topic system of linear equations.

Figure 14 shows the highest percentage (53.1%) of respondents agree that system of linear equations are used in industry. Meanwhile, 28.1% are neutral. The lowest percentage is (3.1%) where the respondents strongly disagree while (6.3%) disagree on the topic. The rest of them were strongly agreed with percentage (9.4%).

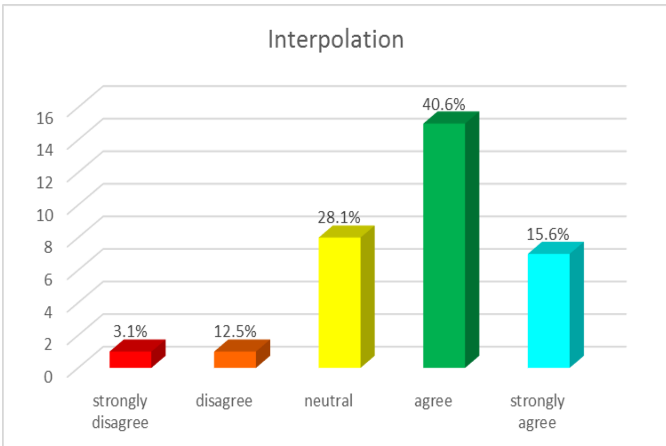

Figure 15: Requirements on topicinterpolation.

Figure 15 shows the highest percentage (40.6%) of respondents agree and (28.1%) neutral that interpolation is used in industry. The lowest percentage is (3.1%) for which respondents strongly disagree while (12.5%) disagree on the topic. The rest of them were strongly agreed with percentage (15.6%).

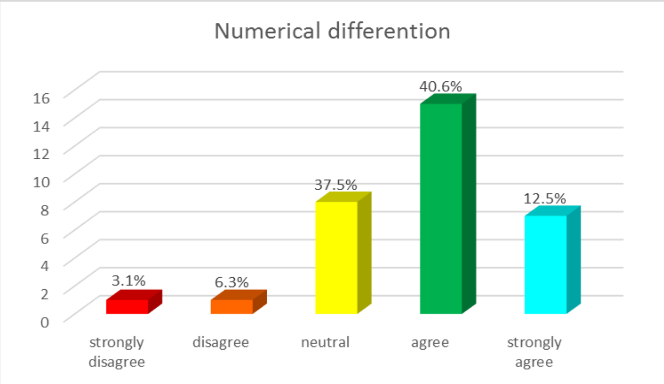

Figure 16: Requirements on topic numerical differentiation.

Figure 16 shows the highest percentage (40.6%) of respondents agree and (37.5%) neutral that numerical differentiation is used in industry. The lowest percentage is (3.1%) which respondents strongly disagree and (6.3%) disagree. The rest of them were strongly agreed with percentage (12.5%).

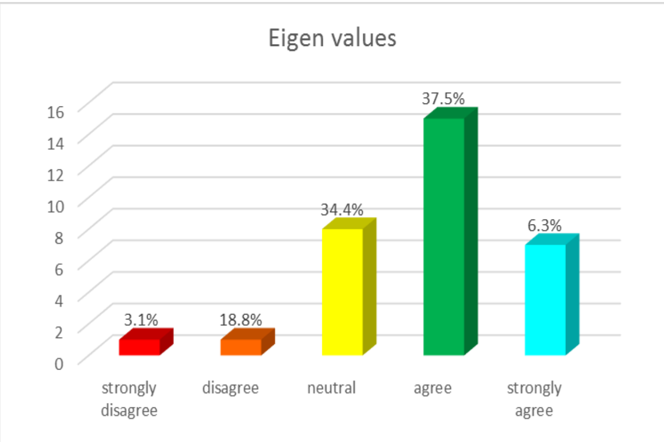

Figure 17: Requirements on topic eigen values.

Figure 17 shows the highest percentage (37.5%) of respondentsagree and (34.4%) neutral that eigen values is used in industry. The lowest percentage is (3.1%) which respondents strongly disagree and (18.8%) disagree on the topic. The rest of them were strongly agreed with percentage (6.3%).

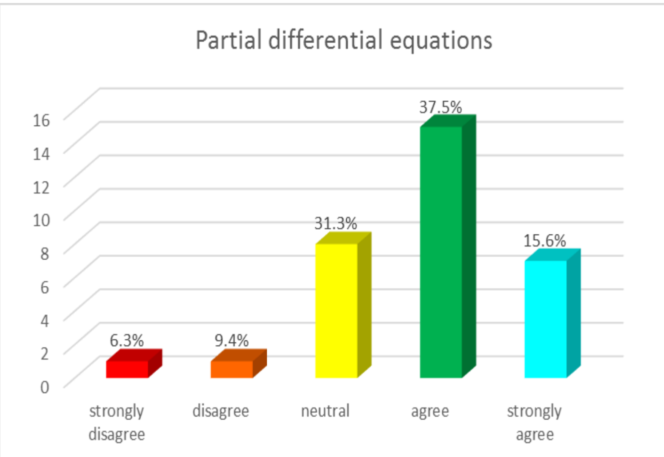

Figure 18: Requirements on topic partial differential equations.

Figure 18 shows the highest percentage (37.5%) of respondents agree and (31.3%) neutral that partial differential equations are used in industry. The lowest percentage is (6.3%) which least respondents strongly disagree and (9.4%) disagree on the topic. The rest of them were strongly agreed with percentage (15.6%).

Table 2: Summary of Results

No	Syllabus	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
1	Limit And Continuity	21.9	**46.9**	25	3.1	3.1
2	Differentiation And Application	18.8	**53.1**	21.9	3.1	3.1
3	Integration	25	**37.5**	31.3	3.1	3.1
4	Power Series	**31.3**	**34.4**	28.1	3.1	3.1
5	Value Vector Functions.	18.8	**50.0**	21.9	6.3	3.1
6	Introduction to Differential Equations.	15.6	**40.6**	34.4	6.3	3.1
7	First Order Differential Equations	12.5	**40.6**	**37.5**	6.3	3.1
8	Second Order Differential Equations.	12.5	**40.6**	**37.5**	6.3	3.1
9	Laplace Transform	9.4	**37.5**	**37.5**	9.4	**6.3**
10	Numerical Solution.	12.5	**43.8**	31.3	9.4	3.1
11	Function of Several Variables	12.5	**46.9**	28.1	9.4	3.1
12	Multiple Integration	9.4	**50.0**	31.3	6.3	3.1
13	Non-Linear Equations	9.3	**43.8**	**37.5**	6.3	3.1
14	System of Linear Equations	9.4	**53.1**	28.1	6.3	3.1
15	Interpolation	15.6	**40.6**	28.1	12.5	3.1
16	Numerical Differentiation	12.5	**40.6**	**37.5**	6.3	3.1
17	Eigen Values	6.3	**37.5**	34.4	**18.8**	3.1
18	Partial Differential Equations	15.6	**37.5**	31.3	9.4	**6.3**

Table 2 illustrates the summary of the respondents where majority of them Agreeall topics (18 topics) should be taught in FTK. The percentage for Agreeshows the highestscale for all topics (see column 3 of Table 2 and Figure 19). The highest percentage Strongly Agree is Power Series(i.e. 31.3%). The highest percentage of Strongly DisagreeareLaplace Transformand Partial Differential Equations(i.e. 6.3%). Meanwhile, the highest percentage ofNeutralareFirst Order Differential Equation, Second Order Linear Differential Equation, Laplace Transform, Non-linear Equations and Numerical Differentiation(i.e. 37.5%). Moreover, the highest percentage of Disagreeis Eigen value(i.e. 18.8%).

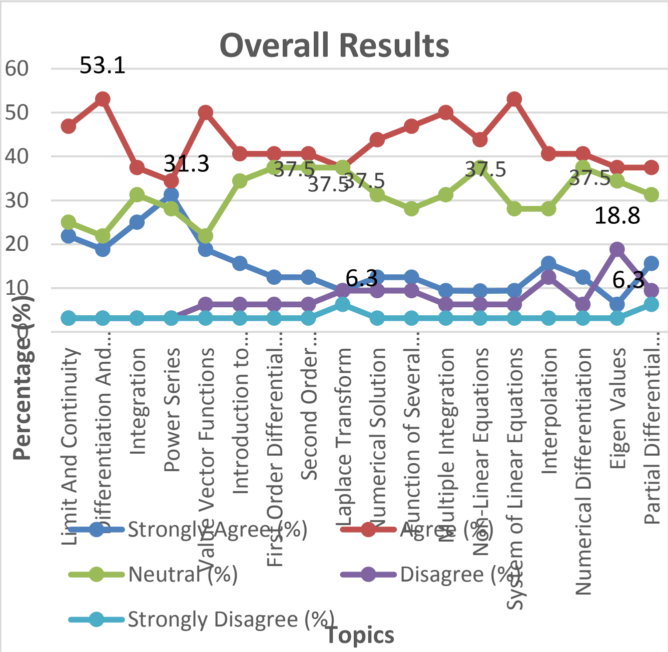

Figure 19: Overall Results

Conclusion

In a nutshell, Mathematic is really important subject and the majority companies agreed that the topics taught for engineering technology students, particularly in FTK are very useful to the industry. However, some modifications of math syllabus are required to ensure that the topics are relevant in industries. Further study can be carried out to find out why the percentage of Neutral is considerably High (i.e. 37.5%). It shows that the respondents are not sure whether the topics are important or not.

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