Sana'a University
Faculty of Engineering
Mechanical Engineering Department
Mechanical Engineering Program

60. Course Specification of Quality Engineering

I. Course Identification and General Information:						
1.	Course Title:	Quality Engineering**.**				
2.	Course Code & Number:	ME463.				
3.	Credit hours:	C.H				TOTAL CR. HRS.
		Th.	Seminar/Tu	Pr	Tr.	
		2	2	-	-	3
4.	Study level/ semester at which this course is offered:	Fifth Year-First Semester.				
5.	Pre –requisite (if any):	Probability and Statistics.				
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered:	Mechanical Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	Location of teaching the course:	Mechanical Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Abdulsalam Almakhlafy.				
11.	Date of Approval:					

II. Course Description:

Quality Engineering is the science that uses the collected data from the manufacturing products and use statistical analysis to monitor the quality standard of the products. The students will learn types of products data and how to apply statistical methods to analyze process and plant data. They will understand statistical quality control, statistical process control, six sigma and related topics. customer quality needs and implement monitoring and statistical methods to improve control. A comprehensive coverage of modern quality control techniques to include the design of statistical process control systems, acceptance sampling, and process improvement is presented.

III. Alignment course intended learning outcomes (CILOs)		Referenced PILOs
a1	Describe variation in a process or data, using frequency distribution, histogram, stem-and-leaf plot, box plot, and normal probability plot.	A1
a2	Recognize process defects using Binomial, Poisson, Normal, and Exponential distribution functions.	A1

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a3	Identify the principles of quality, confirming to standard, defective, the quality improvement tools and 6 sigma and understand their impact in a global environment and societal contexts.	A3
a4	List different quality improvement tools and computer software as problem solving tools and methods for process control and capability analysis and statistical inferences.	A4
b1	Evaluate variation in a product, process or data by using the frequency distribution, histogram, stem-and-leaf plot, box plot, normal probability of data readings of a process.	B1
b2	Explore the basic methods of statistical process control (SPC) as problem solving tools and methods for process control and capability analysis and statistical inferences.	B2
b3	Construct, revised and interpret control charts for variables and attributes.	B2
c1	Calculate and draw control charts using MS EXCEL, SPSS, and MINITAB software.	C1
c2	Calculate and interpret process capability ratios (Cp, Cpk, and Cpkm).	C1
d1	Cooperate effectively in groups and function on multi-disciplinary teams.	D1
d2	Assess and share ideas effectively with other both orally and in writing technical reports.	D5

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1- Describe variation in a process or data, using frequency distribution, histogram, stem-and-leaf plot, box plot, and normal probability plot.	Lectures, Tutorials, Seminars, Projects.	Examinations, Homework Presentations, Individual and Group Project Reports
a2- Recognize process defects using Binomial, Poisson, Normal, and Exponential distribution functions.	Lectures, Tutorials, Seminars, Projects.	Examinations, Homework Presentations,

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a3- Identify the principles of quality, confirming to standard, defective, the quality improvement tools and 6 sigma and understand their impact in a global environment and societal contexts.	Lectures, Tutorials, Seminars, Projects.	Examinations, Homework Presentations,
a4- List different quality improvement tools and computer software as problem solving tools and methods for process control and capability analysis and statistical inferences.	Lectures, Tutorials, Seminars, Projects.	Examinations, Homework Presentations, Individual and Group Project Reports

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1- Evaluate variation in a product, process or data by using the frequency distribution, histogram, stem-and-leaf plot, box plot, normal probability of data readings of a process.	Lectures, Tutorials, Seminars, Projects.	Examinations, Homework Presentations, Individual and Group Project Reports
b2- Explore basic methods of statistical process control (SPC) as problem solving tools and methods for process control and capability analysis and statistical inferences.	Lectures, Tutorials, Seminars, Projects.	Examinations, Homework Presentations, Individual and Group Project Reports project reports
b3- Construct, revised and interpret control charts for variables and attributes.	Lectures, Tutorials, Seminars, Projects	Examinations, Homework Presentations, Individual and Group Project Reports

© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1- Calculate and draw control charts using MS EXCEL, SPSS, and MINITAB software.	Lectures, Tutorials, Seminars, Projects	Examinations, Homework Presentations, Individual and Group Project Reports
c2- Calculate and interpret process capability ratios (C_p, C_{pk}, and C_{pkm}).	Lectures, Tutorials,	Examinations, Homework Presentations, Individual

	Seminars, Projects	and Group Project Reports

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- Cooperate effectively in groups and function on multi-disciplinary teams.	Seminars, Projects	Presentations, Individual and Group Project Reports
d2- Assess and share ideas effectively with other both orally and in writing technical reports.	Seminars, Projects	Presentations, Individual and Group Project Reports

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1.	Introduction to Quality, Quality Control and Improvement	a1, a2, a3, a4	• The Meaning of Quality and Quality Improvement. • Dimensions of Quality. • Quality Engineering Terminology • A Brief History of Quality Control and Improvement • Statistical Methods for Quality Control and Improvement. • Management Aspects of Quality Improvement	1	2
2.	Modeling Process Quality	a1, a2, b1	• Describing Variation. • Important Discrete Distributions. • Important Continuous Distributions • Probability Plots • Some Useful Approximations	1	2

3.	Inferences about Process Quality	a3,b1	• Statistics and Sampling Distributions • Point Estimation of Process Parameters • Statistical Inference for Two Samples • Statistical Inference for more than Two Populations	2	4
4.	Methods and Philosophy of Statistical Process Control	a1,a2,a3,a4, b1, b2, b3	• Introduction to statistical process Control • Chance and Assignable Causes of Quality • Statistical Basis of the Control Chart • The Rest of the "Magnificient Seven" • Implementing SPC • An Application of SPC	2	4
5.	Control Charts for Variables	a1,a2,a3,a4, b1, b2, b3, c1	• Introduction • Control Charts for x and R • Control Charts for x and S • The Shewhart Control Chart for Individual Measurements • Summary of Procedures for x, R, and S Charts • Applications of Variables Control Charts	1	2
6.	Mid. Term Exam	a1,a2,a3,a4, b1, b2, b3, c1	• All Previous Topics	1	2
7.	Control Charts for Attributes	a1,a2,a3,a4, b1, b2, b3, c1	• Introduction • Control Charts for Fraction Nonconforming • Control Charts for Nonconformities (Defects) • Choice between Attributes and Variables Control Charts • Guidelines for Implementing Control Charts	1	2

8.	Process and Measurement System Capability Analysis	a1,a2,a3,a4, b1, b2, b3, c1, c2	• Introduction • Process Capability Analysis Using a Histogram or a Probability Plot • Process Capability Ratios • Process Capability Analysis Using a Control Chart • Process Capability Analysis Using Designed Experiments • Gage and Measurement System Capability Studies • Setting specification Limits on Discrete Components	2	4
9.	Acceptance Sampling	a1,b3	• Lot-by-Lot Acceptance Sampling for Attributes • Acceptance Sampling Problem • Single-Sampling Plans for Attributes • Double, Multiple, and Sequential Sampling • Military Standard 105E (ANSI/ASQC Z1.4, ISO 2859)	2	4
10.	Six Sigma	a3	• DMAIC • Application of Six Sigma Tools to Minimize Production Variability • Taguchi Loss Function	1	2
11.	Lean Production and Quality	c2	• The Birth of Lean Production • The Lean Production System Stability • Just-In-Time	1	2
12.	Final Exam	a1,a2,a3,a4, b1, b2, b3, c1, c2	• All Topics	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

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B – Tutorial Aspect:

Order	Units/Topics List	Number of Weeks	Contact hours	Learning Outcomes
1	Introduction to Quality, Quality Control and Improvement	1	2	a1, a2, a3, a4
2	Modeling Process Quality	1	2	a1,a2,b1
3	Inferences about Process Quality	2	4	a3,b1
4	Methods and Philosophy of Statistical Process Control	2	4	a1,a2,a3,a4, b1, b2, b3
5	Control Charts for Variables	1	2	a1,a2,a3,a4, b1, b2, b3, c1
6	Control Charts for Attributes	1	2	a1,a2,a3,a4, b1, b2, b3, c1
7	Process and Measurement System Capability Analysis	2	4	a1,a2,a3,a4, b1, b2, b3, c1, c2
8	Acceptance Sampling	2	4	a1,b3
9	Six Sigma	1	2	a3
10	Lean Production and Quality	1	2	c2
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Lectures
- Tutorials
- Seminars.
- Projects.

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Measure the diameter of 38 pieces of same model and fined the mean and slandered deviation.	a1,a2,	4th week	3

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2	Construct all the necessary diagram	b1,a2,a3,a4	6th week	4
3	Construct the control chart for 20sample each of 5 observations	b2,b3,c1,c2	8th week	4
4	Use software programs to check no.1,2,3	b1	12th week	4
5	Homework	a1,a2,a3,b1,b2,b3,c1,c2,	weekly	15
6	Project Presentation and Reports	a1,a2,a3,b1,b2,b3,c1,c2, d1,d2	4th,10th, and 14th weeks	15
Total				**45**

VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Assignments	Weekly	45	30 %	a2,a3,b1,b2,b3,c1,c2
2	Quizzes	5th , 10th, 13th weeks	10	6.7 %	a2,a3,b1,b2,b3,c1,c2
3	Mid-Term Exam	8th week	20	13.33 %	a1,a2,b1,b2
4	Final Exam	16th week	75	50 %	a2,a3,b1,b2,b3,c1,c2
Total			**150**	**100 %**	

VIII. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1- Montgomery, Douglas C., 2009, Introduction to Statistical Quality Control, Sixth Ed John Wiley and Sons.
2- D.C. Montgomery, G.C. Runger, and N.F. Hubele. Introduction to Engineering Stat Engineering Statistics, Fourth Edition.

2- Essential References.

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	1. Spreadsheet and statistical analysis software to complete some of your homewor 2. Microsoft Excel, SPSS, Minitab, and Design Expert (Stat Ease) are installed o computers in the Lab.
3- Electronic Materials and Web Sites *etc*.	

I. Course Policies:

1	**Class Attendance:** - The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and be considerd as an exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic.
2	**Tardy:** - For lateness in attending the class, the student will be initially notified. If he repeates late in attending class he will be considered absent.
3	**Exam Attendance/Punctuality:** - The student should attend the exam on time. He is permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in the exam.
4	**Assignments & Projects:** - In general one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment
5	**Cheating**: - For cheating in exam, the student is considered as failure. In case the cheating is repeated three times during study the student will be disengaged from the Faculty
6	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Affair Council of the university.
7	**Other policies:** - The mobile phone is not allowable to be used during class lecture. It must be switched off, otherwise the student will be ordered to leave the lecture room. - The mobile phone is not allowed to be taken during the examination time. - Lecture notes and assignments may be given directly to students using soft or hard copy.

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Assoc.Prof. Dr. Khalil Al-Hatab**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

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60. Course Plan of Quality Engineering

I. Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Dr.Abdulsalam Almakhlafy	**Office Hours**					
Location& Telephone No.		**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Drabdulsalam2@gmail.com						

II. Course Identification and General Information:

1.	Course Title:	Quality Engineering**.**				
2.	Course Number & Code:	ME463.				
3.	Credit hours:	C.H				TOTAL CR. HRS.
		Th.	Seminar/Tu	Pr	Tr.	
		2	2	-	-	3
4.	Study level/year at which this course is offered:	Fifth Year-First Semester.				
5.	Pre –requisite (if any):	Probability and Statistics.				
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered	Mechanical Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	System of Study:	Semesters.				
10.	Mode of delivery:	Lectures and Tutorials.				
11.	Location of teaching the course:	Department of Mechanical Engineering				

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III. Course Description:

Quality Engineering is the science that uses the collected data from the manufacturing products and use statistical analysis to monitor the quality standard of the products. The students will learn types of products data and how to apply statistical methods to analyze process and plant data. They will understand statistical quality control, statistical process control, six sigma and related topics. customer quality needs and implement monitoring and statistical methods to improve control. A comprehensive coverage of modern quality control techniques to include the design of statistical process control systems, acceptance sampling, and process improvement is presented.

IV. Intended learning outcomes (ILOs) of the course:

- Brief summary of the knowledge or skill the course is intended to develop**:**

1. Describe variation in a process or data, using frequency distribution, histogram, stem-and-leaf plot, box plot, and normal probability plot.
2. Recognize process defects using Binomial, Poisson, Normal, and Exponential distribution functions.
3. Identify the principles of quality, confirming to standard, defective, the quality improvement tools and 6 sigma and understand their impact in a global environment and societal contexts.
4. List different quality improvement tools and computer software as problem solving tools and methods for process control and capability analysis and statistical inferences.
5. Evaluate variation in a product, process or data by using the frequency distribution, histogram, stem-and-leaf plot, box plot, normal probability of data readings of a process.
6. Explore the basic methods of statistical process control (SPC) as problem solving tools and methods for process control and capability analysis and statistical inferences.
7. Construct, revised and interpret control charts for variables and attributes.
8. Calculate and draw control charts using MS EXCEL, SPSS, and MINITAB software.
9. Calculate and interpret process capability ratios (Cp, Cpk, and Cpkm).
10. Cooperate effectively in groups and function on multi-disciplinary teams.

11. Assess and share ideas effectively with other both orally and in writing technical reports.

V. Course Content:

- Distribution of Semester Weekly Plan of Course Topics/Items and Activities.

A – Theoretical Aspect:

Order	Topics List	Sub Topics List	Week Due	Contact Hours
1.	Introduction to Quality, Quality Control and Improvement	• The Meaning of Quality and Quality Improvement. • Dimensions of Quality. • Quality Engineering Terminology • A Brief History of Quality Control and Improvement • Statistical Methods for Quality Control and Improvement. • Management Aspects of Quality Improvement	1st week	2
2.	Modeling Process Quality	• Describing Variation. • Important Discrete Distributions. • Important Continuous Distributions • Probability Plots • Some Useful Approximations	2nd week	2
3.	Inferences About Process Quality	• Statistics and Sampling Distributions • Point Estimation of Process Parameters • Statistical Inference for Two Samples • Statistical Inference for more than Two Populations	3rd and 4th weeks	4
4.	Methods and Philosophy of Statistical Process Control	• Introduction to statistical process Control • Chance and Assignable Causes of Quality • Statistical Basis of the Control Chart • The Rest of the "Magnificient Seven" • Implementing SPC • An Application of SPC	5th and 6th weeks	4
5.	Control Charts for Variables	• Introduction • Control Charts for x and R	7th week	2

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		• Control Charts for x and S • The Shewhart Control Chart for Individual Measurements • Summary of Procedures for x, R, and S Charts • Applications of Variables Control Charts		
6.	Mid. Term Exam	• All Previous Topics	8th week	2
7.	Control Charts for Attributes	• Introduction • Control Charts for Fraction Nonconforming • Control Charts for Nonconformities (Defects) • Choice between Attributes and Variables Control Charts • Guidelines for Implementing Control Charts	9th week	2
8.	Process and Measurement System Capability Analysis	• Introduction • Process Capability Analysis Using a Histogram or a Probability Plot • Process Capability Ratios • Process Capability Analysis Using a Control Chart • Process Capability Analysis Using Designed Experiments • Gage and Measurement System Capability Studies • Setting specification Limits on Discrete Components	10th and 11th weeks	4
9.	Acceptance Sampling	• Lot-by-Lot Acceptance Sampling for Attributes • Acceptance Sampling Problem • Single-Sampling Plans for Attributes • Double, Multiple, and Sequential Sampling • Military Standard 105E (ANSI/ASQC Z1.4, ISO 2859)	12th and 13th weeks	4
10.	Six Sigma	• DMAIC	14th week	2

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		• Application of Six Sigma Tools to Minimize Production Variability • Taguchi Loss Function		
11.	Lean Production and Quality	• The Birth of Lean Production • The Lean Production System Stability • Just-In-Time	15th week	2
12.	Final Exam	• All Topics	16th week	2
Number of Weeks /and Units Per Semester			**16**	**32**

C – Tutorial Aspect:

Order	Units/Topics List	Number of Weeks	Contact hours
1.	Introduction to Quality, Quality Control and Improvement	1st week	2
2.	Modeling Process Quality	2nd week	2
3.	Inferences about Process Quality	3rd and 4th weeks	4
4.	Methods and Philosophy of Statistical Process Control	5th and 6th weeks	4
5.	Control Charts for Variables	7th week	2
6.	Control Charts for Attributes	9th week	2
7.	Process and Measurement System Capability Analysis	10th and 11th weeks	4
8.	Acceptance Sampling	12th and 13th weeks	4
9.	Six Sigma	14th week	2
10.	Lean Production and Quality	15th week	2
Number of Weeks /and Units Per Semester		**14**	**28**

VI. Teaching strategies of the course:

- Lectures
- Tutorials
- Seminars.

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- Projects.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Measure the diameter of 38 pieces of same model and fined the mean and slandered deviation.	a1,a2,	4th week	3
2.	Construct all the necessary diagram	b1,a2,a3,a4	6th week	4
3.	Construct the control chart for 20sample each of 5 observations	b2,b3,c1,c2	8th week	4
4.	Use software programs to check no.1,2,3	b1	12th week	4
5.	Homework	a1,a2,a3,b1,b2,b3,c1,c2,	weekly	15
6.	Project Presentation and Reports	a1,a2,a3,b1,b2,b3,c1,c2, d1,d2	4th,10th, and 14th weeks	15
Total				**45**

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	Assignments	Weekly	45	30 %
2	Quizzes	5th , 10th, 13th weeks	10	6.67 %
3	Mid-Term Exam	8th week	20	13.33 %
4	Final Exam	16th week	75	50 %
Total			**150**	**100 %**

IX. Learning Resources:

• *Written in the following order: (Author – Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1- Montgomery, Douglas C. ,2009, Introduction to Statistical Quality Control, Sixth Ed John Wiley and Sons. 2- D.C. Montgomery, G.C. Runger, and N.F. Hubele, Introduction to Engineering Statistics, Engineering Statistics, Fourth Edition.
2- Essential References.
1. Spreadsheet and statistical analysis software to complete some of your homework 2. Microsoft Excel, SPSS, Minitab, and Design Expert (Stat Ease) are installed on th computers in the Lab.
3- Electronic Materials and Web Sites *etc*.
1-

II. Course Policies:

1	**Class Attendance:** - The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and be considerd as an exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic.
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7	**Other policies:**

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	- The mobile phone is not allowable to be used during class lecture. It must be switched off, otherwise the student will be ordered to leave the lecture room. - The mobile phone is not allowed to be taken during the examination time. - Lecture notes and assignments may be given directly to students using soft or hard copy.

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