# Course Specification
## (Bachelor)

| | |
|---|---|
| **Course Title:** | **Engineering Statistics and Probability** |
| **Course Code:** | **ME 2020** |
| **Program:** | **Mechanical Engineering** |
| **Department:** | **Mechanical Engineering** |
| **College:** | **Engineering and Architecture** |
| **Institution:** | **Umm Al-Qura University** |
| **Version:** | *Course Specification Version Number* |
| **Last Revision Date:** | *Pick Revision Date.* |

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## A. General information about the course:

### 1. Course Identification

| 1. Credit hours: ( 3 ) | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **2. Course type** | | | | | |
| **A.** | ☐University | ☒ College | ☐ Department | ☐Track | ☐Others |
| **B.** | ☒ Required | | ☐Elective | | |
| **3. Level/year at which this course is offered: (Level 6)** | | | | | |
| **4. Course General Description:** | | | | | |
| This course introduces descriptive statistics, basic probability concepts, discrete probability distributions, continuous probability distributions, sampling distributions, inference concerning means, simple linear regression, live data analysis is implemented using standard computer software. | | | | | |
| **5. Pre-requirements for this course** (if any)**:** | | | | | |
| MTH1182 | | | | | |
| **6. Co-requisites for this course** (if any)**:** | | | | | |
| | | | | | |
| **7. Course Main Objective(s):** | | | | | |
| To have students familiarize, understand and explore both elementary probability and basic statistical techniques as applied in solving numerous engineering and scientific problems. | | | | | |

### 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 3 | 100% |
| 2 | E-learning | | |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4 | Distance learning | | |

### 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | 45 |

| | | |
|---|---|---|
| 2. | **Laboratory/Studio** | |
| 3. | **Field** | |
| 4. | **Tutorial** | |
| 5. | **Others (specify)** | |
| **Total** | | 45 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |
| 1.1 | **Perform descriptive statistics calculations, present results in different graphical formats and perform basic probability theorems calculation including Bayes' theorem.** | **K1** | • Lectures: given on topics as class progress, with special consideration within the class to link the existing topic with students' existing knowledge and further with the general overview.<br>• Review: review the content of each lecture and clarify any matters not understood.<br>• Assignment: small groups of students (up to 4) are assigned to join in a team work; which includes real life data generation, statistical analysis, performing appropriate probability calculations for | On completion of each topic, a set of homework problems is assigned and later a 20 minute follow up test (FUT) is given; in addition to problem solving questions in the midterm and final exams, fill-in-blank knowledge items are given. |
| 1.2 | **Understand and Perform probability calculations for discrete probability density functions including Binomial, Hypergeometric, Poisson, Geometric, Multinomial and Chebyshev's theorem.** | **K1** | | |
| 1.3 | **Understand and Perform probability calculations for continuous probability density functions including Normal, Uniform, Lognormal, Gamma, exponential, Beta, Weibull and joint PDFs. Perform calculations for the sampling distribution of the mean (central limit theorem) and the variance (χ2 and F distributions).** | **K1** | | |
| 1.4 | **Understand and perform calculations for parameter estimation, Type I and II errors, hypothesis testing, OC curves,** | **K1** | | |

| Code | Course Learning Outcomes | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | **simple linear regression and correlation.** | | system design applications and submit professional report (the work, which should be completed by week 14, involves look up of reference materials, websites and use of statistical analysis software). | |
| **2.0** | **Skills** | | | |
| 2.1 | **Ability to apply continuously theoretical/practical knowledge of engineering statistics and probability concepts and techniques in solving, designing, performing and communicating various engineering and scientific problems in an integrated knowledge/experience environment and in a variety of context.** | **S1, S2, S3** | • Extensive engineering application examples given in lectures along with class materials as class progress.<br>• Learning encouraged by use of analytical tools in different applications and through discussion of potential application in other areas.<br>• Assignment tasks include some open-ended tasks designed to use real life data and apply predictive, analytical and problem solving approach. | • Problem solving questions are given at the end of each topic, on midterm exam and on end of semester examination.<br>• Group and individual assignments require application of analytical tools in problem solving tasks.<br>• Assessments of student's assignment work include expectation of adequate use of analytical and |

| Code | Course Learning Outcomes | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | | | • In assignment tasks, students need to submit a written professional management report, which require proper style and referencing format as specified in college style manual. In addition, students make a formal full-scale presentation of the work. | communicatio n skills. |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | **Ability to autonomously, responsibly, professionally and ethically use techniques and modern engineering tools effectively using real life data analysis and engineering statistics and probability concept/information** | **V1, V2** | In assignment tasks, students need to work individually as well as in teams, and master real life practices professionally and ethically with self and long-life learning. | • Test questions require interpretation of real-life data analysis and information.<br>• Assessments of students assignment work include expectation of adequate use of numerical and modern engineering tools effectively. |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | **Descriptive Statistics**<br>• **Graphs of frequency distributions**<br>• **Descriptive measures and calculations** | **3** |

| | | |
|---|---|---|
| 2. | **Basic Probability Concepts**<br>• Elementary theorems<br>• Conditional probability<br>• Bayes' theorem | 6 |
| 3. | **Discrete Probability Distributions**<br>• Random variables and chance variability<br>• Probability density functions<br>• Binomial and Hypergeometric distributions<br>• Chebyshev's theorem<br>• Poisson distribution. Multinomial distribution<br>• Simulation concepts using cumulative density functions | 9 |
| 4. | **Continuous Probability Distributions**<br>• Normal distribution<br>• Uniform and lognormal Distributions<br>• Gamma and exponential distributions<br>• Beta and Weibull distributions<br>• Joint probability densities | 9 |
| 5. | **Sampling Distributions**<br>• Sampling distribution of the mean<br>• Central limit theorem<br>• Sampling distribution of the variance | 5 |
| 6. | **Inference Concerning Means**<br>• Point and interval estimation<br>• Type I and Type II errors<br>• Hypothesis testing<br>• Operating characteristic curves | 8 |
| 7. | **Simple Linear Regression**<br>• Method of least square<br>• Correlation | 5 |
| **Total** | | **45** |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | FUT #1 | 4 | 2.5 |
| 2. | FUT #2 | 7 | 2.5 |
| 3. | Midterm exam | 8 | 30 |
| 4. | FUT #3 | 13 | 2.5 |
| 5. | Assignments | 14 | 10 |

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 6. | FUT #4 | 15 | 2.5 |
| 7. | Final exam | 16 | 50 |
| ... | Total | | 100 |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| Essential References | Miller & Freund's Probability and Statistics for Engineers, 9th edition, Pearson, 2019. |
| Supportive References | Douglas C. Montgomery, George C. Runger, "Applied Statistics and Probability for Engineers", 6th edition, John Wiley & Sons, 2014. |
| Electronic Materials | |
| Other Learning Materials | At least, excel based sheets for the data analysis is emphasized. |

### 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities** (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | A lecture room with a capacity of 35 students per session is reasonable. |
| **Technology equipment** (projector, smart board, software) | Computer access for a PC with Microsoft office installed |
| **Other equipment** (depending on the nature of the specialty) | |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | Faculty | Direct (HW assignments, midterm, and final exams) |
| Effectiveness of Students assessment | Students | Indirect (End of Term Survey) |
| Quality of learning resources | Program Coordinator | Direct |
| The extent to which CLOs have been achieved | Faculty | Direct (Samples of graded examination papers and assignment tasks are check marked by an independent member teaching staff). |

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Other | | |

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

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|---|---|
| **COUNCIL /COMMITTEE** | **MECHATRONICS ENGINEERING PROGRAM COMMITTEE** |
| **REFERENCE NO.** | |
| **DATE** | |