



59-Course Specification of Highway Engineering 2

| I. Course Identification and General Information: | | | | | |
|---|--|----------------------------|-----|-----|--------------|
| 1 | Course Title: | Highway Engineering 2 | | | |
| 2 | Course Code & Number: | CE405 | | | |
| 3 | Credit hours: | C.H | | | Credit Hours |
| | | Th. | Tu. | Pr. | Tr. |
| | | 2 | 2 | 2 | |
| 4 | Study level/ semester at which this course is offered: | 2nd Level/ 2nd semester | | | |
| 5 | Pre –requisite (if any): | Highway Engineering 1 | | | |
| 6 | Co –requisite (if any): | ----- | | | |
| 7 | Program (s) in which the course is offered: | Civil Engineering | | | |
| 8 | Language of teaching the course: | English+ Arabic | | | |
| 9 | Location of teaching the course: | Class room+ lab | | | |
| 10 | Prepared By: | Dr. Abdullah A. Al-Maswari | | | |
| 11 | Date of Approval | | | | |

| II. Course Description: |
|--|
| <p>This course deals with basic topics in pavement engineering (material and Pavement design). Actual course content will be fixed but still subjected to the newly updated evolved in the topics through events and publications. It will mainly include the following topics:</p> <p>Pavement materials, which include soil, stone aggregate and Bituminous characteristics and specifications, Different pavement design, in addition design asphalt mixture.</p> |

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| III. Course Intended learning outcomes (CILOs) of the course | | Referenced PILOs |
|--|--|------------------|
| a.1 | Define of mathematics, science and engineering concepts to the Design of Pavement Material, Pavement and Asphaltic Mix problems. | A1 |
| a.2 | Describe the Codes and Standards of practice of pavement and asphaltic mix design effectively and professionally. | A2 |
| a.3 | Define how to use computer programs for pavement and asphaltic mix design. | A3 |
| b.1 | Identify the pavement design problems. | B1 |
| b.2 | Choose appropriate mathematical of mathematics and soil mechanics to design the pavement and asphaltic mix design elements. | B2 |
| c.1 | Design the Pavement and mix, component and process to meet the required needs | C2 |
| c.2 | Apply software for Pavement and mix design. | C3 |
| c.3 | Preform the highway engineering feasibility studies and material design options. | C4 |
| c.4 | Apply of tests in the material highway engineering laboratory to verify some of the material properties. | C1 |
| d.1 | Communicate effectively using written, oral and graphical skills related to highway engineering | D1 |
| d.2 | Engage in life-long learning related to highway engineering | D5 |

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| (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- Define of mathematics, science and engineering concepts to the Design of Pavement Material, Pavement and Asphaltic Mix problems. | Lecture Multimedia Presentations Presentations Tutorial | -Mid Term and Final Exam. - Assignment - Quiz |
| a2- Describe the Codes and Standards of practice of pavement and asphaltic mix design effectively and professionally. | Lecture Multimedia Presentations Presentations Tutorial | -Mid Term and Final Exam. - Assignment - Quiz |
| a3- Define how to use computer programs for pavement and asphaltic mix design | Case study- Individual/group projects Presentations | Project - Exam- Assignment -Quiz |

| (B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies: | | |
|---|--|---|
| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
| b1. Identify the pavement design | Lecture Multimedia Presentations Presentations Reading | -Mid Term and Final Exam. - Assignment |
| b2. Choose appropriate mathematical of mathematics and soil mechanics to design the pavement and asphaltic mix design elements | Lecture Multimedia Presentations Presentations Reading | -Mid Term and Final Exam. - Assignment |

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| (C) 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. Design the Pavement and mix, component and process to meet the required | Lecture Multimedia Presentations Tutorial -Reading | -Mid Term and Final Exam. - Assignment |
| c2. Apply software for Pavement and mix design (C3). | Case study- Individual/group projects Presentations | Project - - Exam- Assignment |
| c3. Perform the highway engineering feasibility studies and material design options | Lecture | Mid Term and Final Exam. - Assignment |
| c.4 Apply of tests in the material highway engineering laboratory to verify some of the material properties | Lab | 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. Communicate effectively using written, oral and graphical skills related to highway engineering | computer lab | project |
| d2. Engage in life-long learning related to highway engineering | computer lab | project |

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| IV. Course Content: | | | | | |
|--|-------------------------------------|--------------------------------------|---|------------------------|----------------------|
| A – Theoretical Aspect: | | | | | |
| No. | Units/Topics List | Learning Outcomes | Sub Topics List | Number of Weeks | contact hours |
| 1 | Introduction | a1-a2 | Type of Pavement | 1 | 2 |
| 2 | Soil engineering for highway design | a1- a2-a-3 -b1-b2-c1- c2-d1-d2 | a. Soil characteristics b. Basic engineering properties of soil c. Classification of soil for highway use d. Soil compaction e. Special soil tests for pavement design (CBR) | 4 | 8 |
| 3 | Asphalt Mixtures | a1- a2-a-3 -b1-b2-c1- c2-d1-d2 | a. Asphalt material Sources, description, uses and, tests. b. Aggregate material c. Sources, gradation, engineering properties and tests d. Methods of Asphalt Mixture Design e. Marshal mixture method | 2 | 4 |
| 4 | Asphalt Mixtures | | a. Asphalt material Sources, description, uses and, tests. b. Aggregate material c. Sources, gradation, engineering properties and tests d. Methods of Asphalt Mixture Design Marshal mixture method | 3 | 6 |
| 5 | Design of Flexible Pavement | a1- a2-a-3 -b1-b2-c1- c2-d1-d2 | a. Structural components of flexible pavements, b. Design parameters, c. Traffic, and environmental characteristics d. Design life e. Pavement design methods f. AASHTO design method | 4 | 8 |
| Number of Weeks /and Units Per Semester | | | | 14 | 28 |

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| B – Tutorial Aspect: | | | | | |
|--|-------------------------------------|--|--|------------------------|----------------------|
| No. | Units/Topics List | Learning Outcomes | Sub Topics List | Number of Weeks | contact hours |
| 1 | Introduction | a1-a2 | Type of Pavement | 1 | 2 |
| 2 | Soil engineering for highway design | a1- a2-a-3 –b1-b2- c1-c2-d1- d2 | a. Soil characteristics b. Basic engineering properties of soil c. Classification of soil for highway use d. Soil compaction e. Special soil tests for pavement design (CBR) | 4 | 8 |
| 3 | Asphalt Mixtures | a1- a2-a-3 –b1-b2- c1-c2-d1- d2 | a. Asphalt material Sources, description, uses and, tests. b. Aggregate material c. Sources, gradation, engineering properties and tests d. Methods of Asphalt Mixture Design Marshal mixture method | 5 | 10 |
| 4 | Design of Flexible Pavement | a1- a2-a-3 –b1-b2- c1-c2-d1- d2 | a. Structural components of flexible pavements, b. Design parameters, c. Traffic, and environmental characteristics d. Design life e. Pavement design methods f. AASHTO design method | 4 | 8 |
| Number of Weeks /and Units Per Semester | | | | 14 | 28 |

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| c- practical Aspect: | | | | |
|--|---|-----------------|---------------|----------------------------------|
| Order | Tasks/ Experiments | Number of Weeks | contact hours | Learning Outcomes |
| 1 | Introduction to lab and subject topics; participation | 1 | 2 | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 |
| 2 | Lab test 1+ assignment | 2 | 4 | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 |
| 3 | Lab test 2+ assignment | 2 | 4 | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 |
| 4 | Lab test 3+ assignment | 2 | 4 | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 |
| 5 | Lab test 4+ assignment | 2 | 4 | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 |
| 6 | lab test 5+ assignment | 2 | 4 | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 |
| 7 | Lab test 5 +assignment | 3 | 6 | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 |
| Number of Weeks /and Units Per Semester | | 14 | 28 | |

| V. Teaching strategies of the course: | |
|--|--|
| Lecture Multimedia Presentations & Tutorial Case study- Individual/group projects Reading Lab | |

| VI. Assignments: | | | | |
|-------------------------|---|-------------------------------|----------|------|
| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
| 1 | Soil classification, compaction, evaluation | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 1,2 | 2.5 |

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| | | | | |
|---|--------------------------------------|-------------------------------|-----|-----|
| 2 | Design examples of asphalt mixtures | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 3,4 | 2.5 |
| 3 | Design examples of flexible pavement | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 5,6 | 2.5 |
| 4 | Field visits report and presentation | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 7,8 | 2.5 |

| VII. Reports: | | | | |
|---------------|-------------------|----------------------------------|----------|------|
| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
| 1 | Lab test 1 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 3 | 4 |
| 2 | Lab test 2 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 5 | 4 |
| 3 | Lab test 3 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 7 | 3 |
| 4 | Lab test 4 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 9 | 3 |
| 5 | lab test 5 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 11 | 3 |
| 6 | Lab test 6 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 14 | 3 |

| VIII. Schedule of Assessment Tasks for Students During the Semester: | | | | | |
|--|--------------------|-----------------|------|----------------------------------|----------------------------------|
| No . | Assessment Method | Week Due | Mark | Proportion of Final Assessment % | Aligned Course Learning Outcomes |
| 1 | Written assignment | 1-14 | 10 | 5 | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 |
| 2 | Quizzes. | Three times | 4 | 2 | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 |
| | Reports | 3.5.7.9.11.14 | 20 | 10 | |
| 3 | Mid-term exam. | 7 th | 40 | 20 | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 |
| 4 | Filed Visit | 12 | 6 | 3 | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 |
| 5 | Final-exam. | 13 | 120 | 60 | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 |

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| | | | | | |
|---|-----|----|-----|------|--|
| 6 | Sum | 14 | 200 | 100% | |
|---|-----|----|-----|------|--|

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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- AASHTO Guide for Design of Pavement Structures edition 1993
- 2- Nichols J. Garber and Lester A. Hoel - 4th edition 2010 – Traffic and Highway Engineering

2- Essential References.

- Dr.L.R. Kadyall and Dr. N.B. Lal - 6th edition 2013 – Principles and Practices of Highway Engineering (Including Expressways and Airport Engineering
- 2- Different Arabic References

3- Electronic Materials and Web Sites etc.

- 1- web site of the local and international organizations related traffic and highway engineering

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| X. Course Policies: | |
|----------------------------|---|
| 1 | Class Attendance: The students should have more than 75 % of attendance according to rules and regulations of the faculty. |
| 2 | Tardy: The students should respect the timing of attending the lectures. They should attend within 1 minutes from starting of the lecture. |
| 3 | Exam Attendance/Punctuality: The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for midterm exam and final exam. |
| 4 | Assignments & Projects: The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time. |
| 5 | Cheating: If any cheating occurred during the examination, the student is not allowed to continue and he/she has to face the examination committee for enquiries . |
| 6 | Plagiarism: The student will be terminated from the Faculty, if one student attends the exam on another behalf according to the policy, rules and regulations of the university. |
| 7 | Other policies: -All the teaching materials should be kept out the examination hall. -The mobile phone is not allowed -There should be a respect between the student and his teacher. |

| | |
|--------------------|---|
| Reviewed By | <u>Vice Dean for Academic Affairs and Post Graduate Studies</u> <u>Dr. Tarek A. Barakat</u> <u>Dr. Mohammad Algorafi</u> |
| | <u>Deputy Rector for Academic Affairs Dr. Ibrahim AlMutaa</u> <u>Dr. Ahmed mujahed</u> <u>Dr. Munaser Alsubri</u> |

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Course Plan (Syllabus) of Highway Engineering 2

| I. Information about Faculty Member Responsible for the Course: | | | | | | | |
|---|----------------------------|--------------|-----|-----|-----|-----|-----|
| Name of Faculty Member | Dr. Abdullah A. Al-Maswari | Office Hours | | | | | |
| Location& Telephone No. | | SAT | SUN | MON | TUE | WED | THU |
| E-mail | | 2 | 2 | 2 | | | |

| II. Course Identification and General Information: | | | | | |
|--|---|---------------------------|-----|-----|-----|
| 1- | Course Title: | Highway Engineering 2 | | | |
| 2- | Course Number & Code: | CE405 | | | |
| 3- | Credit hours: | C.H | | | |
| | | Th. | Tu. | Pr. | Tr. |
| | | 2 | 2 | 2 | |
| 4- | Study level/year at which this course is offered: | 2nd Level/ 2nd semester | | | |
| 5- | Pre –requisite (if any): | Highway Engineering 1 | | | |
| 6- | Co –requisite (if any): | ----- | | | |
| 7- | Program (s) in which the course is offered | Civil Engineering | | | |
| 8- | Language of teaching the course: | English+ Arabic | | | |
| 9- | System of Study: | Semester | | | |
| 10- | Mode of delivery: | Lecture + practical + lab | | | |
| 11- | Location of teaching the course: | Class room +lab | | | |

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III. Course Description:

This course deals with basic topics in pavement engineering (material and Pavement design). Actual course content will be fixed but still subjected to the newly updated evolved in the topics through events and publications. It will mainly include the following topics: Pavement materials, which include soil, stone aggregate and Bituminous characteristics and specifications, Different pavement design, in addition design asphalt mixture.

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

- Brief summary of the knowledge or skill the course is intended to develop:
 - a.1 Define of mathematics, science and engineering concepts to the Design of Pavement Material, Pavement and Asphaltic Mix problems. A1
 - a.2 Describe the Codes and Standards of practice of pavement and asphaltic mix design effectively and professionally. A2
 - a.3 Define how to use computer programs for pavement and asphaltic mix design. A3
 - b.1 **Identify** the pavement design problems. B1
 - b.2 Choose appropriate mathematical of mathematics and soil mechanics to design the pavement and asphaltic mix design elements. B2
 - c.1 Design the Pavement and mix, component and process to meet the required needs C2
 - c.2 Apply software for Pavement and mix design. C3
 - c.3 Perform the highway engineering feasibility studies and material design options. C4
 - c.4 **Apply tests** in the material highway engineering laboratory to verify some of the material properties. C1
 - d.1 Communicate effectively using written, oral and graphical skills related to highway engineering D1
 - d.2 Engage in life-long learning related to highway engineering D5

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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 | Type of Pavement | 1 | 2 |
| 2 | Soil engineering for highway design | a. Soil characteristics b. Basic engineering properties of soil c. Classification of soil for highway use d. Soil compaction e. Special soil tests for pavement design (CBR) | 4 | 8 |
| 3 | Asphalt Mixtures | a. Asphalt material Sources, description, uses and, tests. b. Aggregate material Sources, gradation, engineering properties and tests c. Methods of Asphalt Mixture Design Marshal mixture method | 2 | 4 |
| 4 | Midterm Exam | | 1 | 2 |
| 5 | Asphalt Mixtures | a. Asphalt material Sources, description, uses and, tests. b. Aggregate material Sources, gradation, engineering properties and tests c. Methods of Asphalt Mixture Design Marshal mixture method | 3 | 6 |
| 6 | Design of Flexible Pavement | a. Structural components of flexible pavements, b. Design parameters, c. Traffic, and environmental characteristics d. Design life e. Pavement design methods f. AASHTO design method | 4 | 8 |
| 7 | Final Exam | | 1 | 2 |
| Number of Weeks /and Units Per Semester | | | 16 | 32 |

B – Tutorial Aspect:

| | | | | |
|-------------|--|---|--|--|
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|-------------|--|---|--|--|

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| Order | Topics List | Week Due | Contact Hours |
|---|-------------------------------------|----------|---------------|
| 1 | Introduction | 1 | 2 |
| 2 | Soil engineering for highway design | 4 | 8 |
| 3 | Asphalt Mixtures | 5 | 10 |
| 4 | Design of Flexible Pavement | 4 | 8 |
| Number of Weeks /and Units Per Semester | | 14 | 28 |

| c- practical Aspect: | | | |
|---|---|----------|---------------|
| Order | Topics List | Week Due | Contact Hours |
| 1 | Introduction to lab and subject topics; participation | 1 | 2 |
| 2 | Lab test 1+ assignment | 2 | 4 |
| 3 | Lab test 2+ assignment | 2 | 4 |
| 4 | Lab test 3+ assignment | 2 | 4 |
| 5 | Lab test 4+ assignment | 2 | 4 |
| 6 | lab test 5+ assignment | 2 | 4 |
| 7 | Lab test 5 +assignment | 3 | 6 |
| Number of Weeks /and Units Per Semester | | 14 | 28 |

| VI. Teaching strategies of the course: |
|--|
| Lecture Multimedia Presentations & Tutorial Case study- Individual/group projects Reading Lab |

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| VII. Assignments: | | | | |
|-------------------|---|-------------------------------|----------|------|
| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
| 1 | Soil classification, compaction, evaluation | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 1,2 | 2.5 |
| 2 | Design examples of asphalt mixtures | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 3,4 | 2.5 |
| 3 | Design examples of flexible pavement | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 5,6 | 2.5 |
| 4 | Field visits report and presentation | a1- a2-a-3 –b1-b2-c1-c2-d1-d2 | 7,8 | 2.5 |

| VIII. Reports: | | | | |
|----------------|-------------------|----------------------------------|----------|------|
| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
| 1 | Lab test 1 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 3 | 4 |
| 2 | Lab test 2 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 5 | 4 |
| 3 | Lab test 3 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 7 | 3 |
| 4 | Lab test 4 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 9 | 3 |
| 5 | lab test 5 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 11 | 3 |
| 6 | Lab test 6 report | a1- a2-a-3 –b1-b2-c1-c2-c4-d1-d2 | 14 | 3 |

| IX. Schedule of Assessment Tasks for Students During the Semester: | | | | |
|--|--------------------------|-----------------|------|--------------------------------|
| Assessment | Type of Assessment Tasks | Week Due | Mark | Proportion of Final Assessment |
| 1 | Written assignment | 1-14 | 10 | 5 |
| 2 | Quizzes. | Three times | 4 | 2 |
| 3 | Reports | 3.5.7.9.11.14 | 20 | 10 |
| 4 | Mid-term exam. | 7 th | 40 | 20 |
| 5 | Filed Visit | 12 | 6 | 3 |
| 6 | Final-exam. | 13 | 120 | 60 |

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AL-Bukhaiti

Academic Development
Center & Quality Assurance
Ass. Prof. Dr.
Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas



| X. Learning Resources: | |
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| <ul style="list-style-type: none"> • Written in the following order: (Author – Year of publication – Title – Edition – Place of publication – Publisher). | |
| 1- Required Textbook(s) (maximum two). | |
| <p>1- AASHTO Guide for Design of Pavement Structures edition 1993</p> <p><i>Nichols J. Garber and Lester A. Hoel</i> - 4th edition 2010 – Traffic and Highway Engineering</p> | |
| 2- Essential References. | |
| <p>- Dr.L.R. Kadyall and Dr. N.B. Lal - 6th edition 2013 – Principles and Practices of Highway Engineering (Including Expressways and Airport Engineering</p> <p>2- Different Arabic References</p> | |
| 3- Electronic Materials and Web Sites etc. | |
| <p>1- web site of the local and international organizations related traffic and highway engineering</p> | |

Prepared by Head of Department
Dr. Abdulkareem
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| XI. Course Policies: | |
|--|---|
| Unless otherwise stated, the normal course administration policies and rules of the Faculty of ----- apply. For the policy, see: ----- | |
| 1 | Class Attendance: The students should have more than 75 % of attendance according to rules and regulations of the faculty. |
| 2 | Tardy: The students should respect the timing of attending the lectures. They should attend within 1 minutes from starting of the lecture. |
| 3 | Exam Attendance/Punctuality: The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for midterm exam and final exam. |
| 4 | Assignments & Projects: The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time. |
| 5 | Cheating: If any cheating occurred during the examination, the student is not allowed to continue and he/she has to face the examination committee for enquiries . |
| 6 | Plagiarism: The student will be terminated from the Faculty, if one student attends the exam on another behalf according to the policy, rules and regulations of the university. |
| 7 | Other policies: _ All the teaching materials should be kept out the examination hall. _ The mobile phone is not allowed. _ There should be a respect between the student and his teacher. |

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