**RAIL SYSTEMS MSc (non-thesis) PROGRAMME**

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| **First Year** |
| **I. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505201501 | [FUNDAMENTALS OF RAIL SYSTEMS](#EN1) | 7.5 | 3+0 | 3 | **C** | Turkish |
|  | Elective Course-1 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-2 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-3 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Total of I. Semester  | 30 |  | 12 |  |  |
| **II. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
|  | Elective Course-4 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-5 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-6 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-7 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Total of II. Semester  | 30 |  | 12 |  |  |
|  | TOTAL OF FIRST YEAR | 60 |  | 24 |  |  |

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| **Second Year** |
| **III. Semester** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
|  | Elective Course-8 | 7.5 | 3+0 | 3 | E | Turkish |
|  | Elective Course-9 | 7.5 | 3+0 | 3 | E | Turkish |
|  | TERM PROJECT | 15 | 0+2 | - | **C** | Turkish |
|  | Total of III. Semester  | 30 |  |  |  |  |
|  | TOTAL OF SECOND YEAR | 30 |  |  |  |  |

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| **Elective Courses** |
| Code | Course Title | ECTS | T+P | Credit | C/E | Language |
| 505202504 | [ADVANCED RAILWAY SIGNALING](#EN6) | 7.5 | 3+0 | 3 | E | Turkish |
| 505201506 | [BUSINESS ECONOMICS](#EN8) | 7.5 | 3+0 | 3 | E | Turkish |
| 505201505 | [CERTIFICATION OF ROLLING STOCK](#EN7) | 7.5 | 3+0 | 3 | E | Turkish |
| 505202507 | [DIAGNOSTICS AND MONITORING IN RAILWAY SYSTEMS](#EN11) | 7.5 | 3+0 | 3 | E | Turkish |
| 505202506 | [DYNAMİCS OF RAİLWAY VEHİCLE SYSTEMS](#EN13) | 7.5 | 3+0 | 3 | E | Turkish |
| 505201502 | [ELECTRIC TRACTION](#EN2) | 7.5 | 3+0 | 3 | E | Turkish |
| 505202505 | [INTRODUCTİON TO RAİLWAY-VEHİCLE AND TRACK INTERACTİON](#EN12) | 7.5 | 3+0 | 3 | E | Turkish |
| 505201503 | [MULTI-AGENT SYSTEMS FOR TRAFFIC AND TRANSPORTATION](#EN3) | 7.5 | 3+0 | 3 | E | Turkish |
| 505202501 | [RAIL SYSTEMS ELECTRIFICATION](#EN4) | 7.5 | 3+0 | 3 | E | Turkish |
| 505202503 | [RAILWAY COMMUNICATION SYSTEMS](#EN5) | 7.5 | 3+0 | 3 | E | Turkish |
| 505202504 | [STRATEGIC MANAGEMENT ACCOUNTING](#EN9) | 7.5 | 3+0 | 3 | E | Turkish |

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |  F-S |

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| **COURSE** |
| **CODE** |  505201501 | **TITLE** |  FUNDAMENTALS OF RAIL SYSTEMS |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  |    |  | 3 | 7,5 | COMPULSORY(X ) | ELECTIVE(   ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2  | 60 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |      Introduction, Station Layout, Rolling Stock, Depots and Workshops, Track, Earthworks, Drainage and Fencing , Bridges and Structures , Tunnels and Tunnelling, Electrification, Signalling and Train Control, Systems and Communications, Lifts, Escalators and Pumps, Ventilation and Draught Relief, and Future Trends  |
| **COURSE OBJECTIVES** |     To provide an introduction to the rail systems engineering, to develop an understanding of the engineering concepts involved, for all disciplines, in the planning, design, construction, equipping, maintenance and renewal of all types of railway.    |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Having taken this course, students will have an overall understanding of railway systems, railway terminology, and importance of railways in transportation systems. |
| **LEARNING OUTCOMES OF THE COURSE** |  Ability to determine, define, formulate and solve complex engineering and management problemsAbility to develop, select and use modern methods and tools required for engineering and management applications,Ability to effectively use of information technologies. |
| **TEXTBOOK** |      Clifford F Bonnett, Practical Railway Engineering, 2nd ed, London: Imperial College Press, 2005   |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Introduction |
| 2 | Station Layout |
| 3 | Rolling Stock |
| 4 | Depots and Workshops |
| 5 | Track |
| 6 | Midterm Examination 1 |
| 7 | Earthworks, Drainage and Fencing |
| 8 | Bridges and Structures |
| 9 | Tunnels and Tunnelling |
| 10 | Electrification |
| 11 | Midterm Examination 2 |
| 12 | Signalling and Train Control |
| 13 | Systems and Communications |
| 14 | Lifts, Escalators and Pumps, Ventilation and Draught Relief, and Future Trends |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  |  **x** |  |  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  |  **x** |  |  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  |  | **x**  |  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **x**  |  |  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **x** |  |  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. |  | **x** |  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. |  | **x** |  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **x**  |  |  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. |  |  | **x** |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. |  |  |  **x** |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. |  |  **x** |  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. |  | **x** |  |
| **Prepared by :**  | Hasan Huseyin ERKAYA | **Date:** | **June 6, 2015** |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |  Fall |

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| **COURSE** |
| **CODE** |       505201502 | **TITLE** |       ELECTRIC TRACTION |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3 | 0 | 0 | 3 | 7,5 | COMPULSORY(   ) | ELECTIVE(   x) |      Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 60 |
| Quiz |  |  |
| Homework |  |  |
| Project |  |  |
| Report |  |  |
| Seminar |  |  |
| Other (     ) |   |    |
| **Final Examination** |   40 |
| **PREREQUISITE(S)** | Fundamentals of DC and AC Circuit Analysis |
| **SHORT COURSE CONTENT** | DC traction motors and drives, AC traction motors and drives, wear in electric motors, material fatigue, insulation materials, conductors, solder metallurgy, overhaul of motors, maintenance and certification |
| **COURSE OBJECTIVES** | The principles of electric traction motors, their production and maintenance procedures will be explained to achieve a better understanding of rail systems. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | Those who complete this course successfully will have a better understanding of locomotive, tram, and multiple unit production and maintenance |
| **LEARNING OUTCOMES OF THE COURSE** | Modeling DC traction motorsModeling AC traction motorsDesigning drivers for AC and DC traction motors |
| **TEXTBOOK** | Electric Motors and Drives - Fundamentals, Types and Applns 3rd ed - A. Hughes (Newnes, 2006) |
| **OTHER REFERENCES** | *Güç Elektroniği*, Osman Gürdal, Seçkin Yayıncılık, 2008*Power Electronics: Converters, Applications, and Design* N. Mohan, T. M. Undeland, William P. Robbins (Wiley, 2003) |
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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Magnetic fields, fluxes and forces |
| 2 | DC electric motor structure |
| 3 | Voltage, current, power and speed relations for DC motors |
| 4 | DC motor drives |
| 5 | Universal motor |
| 6 | Mid-Term Examination 1 |
| 7 | AC electric motor structure |
| 8 | Voltage, current, power and speed relations for AC motors |
| 9 | AC motor drives |
| 10 | Regenerative breaking |
| 11 | Mid-Term Examination 2 |
| 12 | Motors employed in rail systems and their production |
| 13 | Wear and fatigue in motors; motor overhaul |
| 14 | Maintenance processes and certification |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  |  **x** |  |  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  |  **x** |  |  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  |  | **x**  |  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **x**  |  |  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **x** |  |  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. |  | **x** |  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. |  | **x** |  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **x**  |  |  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. |  |  | **x** |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. |  |  |  **x** |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. |  |  **x** |  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. |  | **x** |  |
| **Prepared by :**  |   Hasan Huseyin ERKAYA     | **Date:** |  June 6, 2015      |
|  |  |  |  |  |  |  |  |  |  |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |  Fall |

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| **COURSE** |
| **CODE** |       505201501 | **TITLE** |       MULTI-AGENT SYSTEMS FOR TRAFFIC AND TRANSPORTATION |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3 | 0 | 0 | 3 | 7,5 | COMPULSORY(   ) | ELECTIVEx ) |      Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |  |  |
| Homework |  |  |
| Project | 1 | 40 |
| Report |  |  |
| Seminar |  |  |
| Other (     ) |   |    |
| **Final Examination** |   30 |
| **PREREQUISITE(S)** | Programming, Artificial Intelligence and Multi-Agent Systems Basics |
| **SHORT COURSE CONTENT** | Multi-Agent Systems, traffic and transportation systems, autonomous junction control, traffic simulation, traffic management, traffic flow |
| **COURSE OBJECTIVES** | Ability to use multi-agent systems in traffic and transportation problems |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | Ability to determine, define, formulate and solve complex Rail Systems engineering problems Ability to select and use convenient analytical and experimental methods |
| **LEARNING OUTCOMES OF THE COURSE** | Knowledge on multi-agent systemsAbility to use multi-agent systems in engineering design |
| **TEXTBOOK** | Multi-Agent Systems for Traffic and Transportation EngineeringAna Bazzan and Franziska Klügl, 2009. |
| **OTHER REFERENCES** | Multi Agent Systems, G Weiss, MIT Press, 2013, [G Weiss](http://www.weiss-gerhard.info/) <http://www.the-mas-book.info/> [slides](http://www.the-mas-book.info/index-lecture-slides.html)**An Introduction to Multi Agent Systems, M Woodridge, John Wiley & Sons, 2009,** [**http://www.cs.ox.ac.uk/people/michael.wooldridge/pubs/imas/IMAS2e.html**](http://www.cs.ox.ac.uk/people/michael.wooldridge/pubs/imas/IMAS2e.html)[**slides**](http://www.cs.ox.ac.uk/people/michael.wooldridge/pubs/imas/distrib/powerpoint-slides/)[**http://www.kurser.dtu.dk/2013-2014/13450.aspx?menulanguage=en-gb**](http://www.kurser.dtu.dk/2013-2014/13450.aspx?menulanguage=en-gb) |
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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Introduction to multi-agent systems |
| 2 | Architecture, Design and Applications |
| 3 | Traffic and transportation systems |
| 4 | Methods and their utilization |
| 5 | Smart traffic systems |
| 6 | Midterm Examination 1 |
| 7 | Autonomous Junction Control |
| 8 | Traffic Simulation |
| 9 | Traffic Management |
| 10 | Traffic flow |
| 11 | Midterm Examination 2 |
| 12 | Project tests |
| 13 | Project report format and style |
| 14 | Project presentation |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  |  **x** |  |  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  |  **x** |  |  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  |  | **x**  |  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **x**  |  |  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **x** |  |  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. |  | **x** |  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. |  | **x** |  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **x**  |  |  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. |  |  | **x** |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. |  |  |  **x** |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. |  |  **x** |  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. |  | **x** |  |
| **Prepared by :**  |    Muammer AKÇAY    | **Date:** |   June 6, 2015     |
|  |  |  |  |  |  |  |  |  |  |

**Signature**:

**T.R.**

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**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** | 505202501 | **TITLE** |       RAIL SYSTEMS ELECTRIFICATION |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** |   3 |    |    | 3  | 7,5    | COMPULSORY(   ) | ELECTIVE( x  ) |      Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2  |   60 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40   |
| **PREREQUISITE(S)** | Fundamentals of DC and AC Circuit Analysis |
| **SHORT COURSE CONTENT** | Generation and distribution of electric power, transformers, catenary systems, conductor rail, grounding, AC and DC electrification, safety issues, electromagnetic interference. |
| **COURSE OBJECTIVES** | The electrical power supplication process will be explained in detail. Alternative methods and system components will be introduced. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | Those who complete this course successfully will be competent in designing, installation and maintenance of electric railways. |
| **LEARNING OUTCOMES OF THE COURSE** |  Providing fundamental knowledge on electric rail systems engineering |
| **TEXTBOOK** | Kiessling, Puschmann, Schmieder, and Schneider, *Contact Lines for Electric Railways: Planning, Design, implementation and maintenance*, 2nd Ed., Ed: Siemens, Berlin: Publicis Publishing, 2012. |
| **OTHER REFERENCES** | *Electric Power Generation, Transmission, and Distribution*, 2nd Ed., Leonard Lee Grigsby, editor, Boca Raton: CRC Press, 2006.*Electric Power: Generation, Transmission, and Efficiency*, Clément M. Lefebvre (editor). New York: Nova Science Publishers, Inc. 2007 *Elektrik Enerjisi Üretimi ve Dağıtımı*, Erdal Turgut ve Korkmaz Selçuk, Detay Yayıncılık, 2009 |
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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Electric Power Generation |
| 2 | Electric Power Distribution |
| 3 | High voltage transformers |
| 4 | Circuit Breakers |
| 5 | High voltage AC catenary system |
| 6 | Midterm Examination 1 |
| 7 | Low voltage DC catenary system |
| 8 | Conductor rail systems |
| 9 | Rectifiers |
| 10 | Grounding Systems |
| 11 | Midterm Examination 2 |
| 12 | Regenerative breaking |
| 13 | Electromagnetic interference |
| 14 | Safety issues |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  |  **x** |  |  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  |  **x** |  |  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  |  | **x**  |  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **x**  |  |  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **x** |  |  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. |  | **x** |  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. |  | **x** |  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **x**  |  |  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. |  |  | **x** |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. |  |  |  **x** |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. |  |  **x** |  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. |  | **x** |  |
| **Prepared by :**  |       Hasan Huseyin ERKAYA | **Date:** |       June 6, 2015 |
|  |  |  |  |  |  |  |  |  |  |

**Signature**:

**T.R.**

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**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |    505202503    | **TITLE** |      RAILWAY COMMUNICATION SYSTEMS  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** |   3 |    |    | 3   |  7,5   | COMPULSORY(   ) | ELECTIVE(x   ) |      Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm |  2 |   60 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40   |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** | Introduction to Communication Systems, Analog Data Communication Systems, Digital Data Communication Systems, Wireless Communication and Wireless Network, Satellite Communication, Inter and Intra Vehicle Communications, New Advances in Railway Communication Systems. |
| **COURSE OBJECTIVES** | to introduce railway communication systems and teach their theories. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | Students will learn analog and digital communication methods used in railway signaling and use them in railway systems. |
| **LEARNING OUTCOMES OF THE COURSE** |  Ability to use of information technologies effectively. |
| **TEXTBOOK** | B.P. Lathi ve Zhi Ding, *Modern Digital and Analog Communication Systems*, Oxford University Press, 2008.       |
| **OTHER REFERENCES** |        |
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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Communication Systems |
| 2 | Analog Data Communication Systems |
| 3 | Analog Data Communication Systems |
| 4 | Digital Data Communication Systems |
| 5 | Digital Data Communication Systems |
| 6 | Midterm Examination 1 |
| 7 | Wireless Communication and Wireless Network |
| 8 | Wireless Communication and Wireless Network |
| 9 | Satellite Communication |
| 10 | Satellite Communication |
| 11 | Midterm Examination 2 |
| 12 | Inter and Intra Vehicle Communications |
| 13 | Railway Communication Systems |
| 14 | New Advancements |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  |  **x** |  |  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  |  **x** |  |  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  |  | **x**  |  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **x**  |  |  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **x** |  |  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. |  | **x** |  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. |  | **x** |  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **x**  |  |  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. |  |  | **x** |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. |  |  |  **x** |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. |  |  **x** |  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. |  | **x** |  |
| **Prepared by :**  |   Rıfat EDİZKAN     | **Date:** |       June 6, 2015 |
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**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |       505201504 | **TITLE** |       ADVANCED RAILWAY SIGNALING |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3   |    |    | 3   |   7,5  | COMPULSORY(   ) | ELECTIVE(x   ) |      Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report | 1 | 30 |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 30   |
| **PREREQUISITE(S)** |       none |
| **SHORT COURSE CONTENT** | Signals and their aspects, signal plans, train control methods, cab signaling, train supervision, communication-based train control, ETCS and other advanced signaling systems |
| **COURSE OBJECTIVES** | Aim is to teach railway signaling systems and principles of signaling planing.  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** | Knowledge on signaling applications on railway. |
| **LEARNING OUTCOMES OF THE COURSE** | Knows the signaling systems used on the railway.Can apply the signaling rules on the signaling system design. |
| **TEXTBOOK** | Introduction to North American Railway Signaling Instution of Railway Signal Engineering, Simons-Boardman Books, 2008. |
| **OTHER REFERENCES** | Signals and their aspects, signal plans, train control methods, cab signaling, train supervision, communication-based train control, ETCS and other advanced signaling systems |
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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 | Introduction to Signaling and History  |
| 2 | Signaling System Components |
| 3 | Signals and Their Aspects |
| 4 | Track circuits and axle counters |
| 5 | Introduction to Signaling and History  |
| 6 | Midterm Examination 1 |
| 7 | Single line operation |
| 8 | Interlocking and Block Systems |
| 9 | Centralized Traffic Control System |
| 10 | Communication-based Train Control , Cab signaling |
| 11 | Midterm Examination 2 |
| 12 | Automatic Train Supervision, Automatic Train Protection and Automatic Train Operation |
| 13 | ERTMS/ECTS and Advanced Railway Signaling Systems |
| 14 | Level Crossings |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  | **x** |  |  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  | **x** |  |  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  |  | **x** |  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **x** |  |  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **x** |  |  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. |  | **x** |  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. |  | **x** |  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **x** |  |  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. |  |  | **x** |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. |  |  | **x** |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. |  | **x** |  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. |  | **x** |  |
| **Prepared by :**  |      RIFAT EDIZKAN  | **Date:** |       June 6, 2015 |
|  |  |  |  |  |  |  |  |  |  |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505201505 | **TITLE** |  Certification of Rolling Stock |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 40 |
| Quiz |   |    |
| Homework |   |    |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Stakeholders and Definition of Terms in the Certification Process, Assessment Modules, Certifications Prepared by NoBo and Applicant, Verification, Technical File, TSIs, UTPs, Equivalant of TSIs and UTPs, Tests  |
| **COURSE OBJECTIVES** |  Understanding of terms in the certification process, certification process, stakeholders  |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Students who successfully complete this course will have information about the certification process |
| **LEARNING OUTCOMES OF THE COURSE** |  TSIs will be known ENs ve UICs related rolling stock will be knownDutis of certification body will be knownTests for rolling stock will be known |
| **TEXTBOOK** |  Application guide for technical specifications for interoperability. General part of the guide explains TSI-related provisions of the Interoperability Directive and general principles applicable to all TSIs. ERA. |
| **OTHER REFERENCES** |  Locomotives and passenger rolling stock - LOC & PAS TSI, Noise - NOI TSI, Wagons - WAG TSI |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Stakeholders in the Certification Process |
| 3 |  Terms in the Certification Process |
| 4 |  Assessment Modules |
| 5 |  Certifications Prepared by NoBo |
| 6 | Midterm Examination 1 |
| 7 |  Certifications Prepared by Applicant |
| 8 |  Verification and Technical File |
| 9 |  TSIs |
| 10 |  UTPs |
| 11 | Midterm Examination 2 |
| 12 |  Equivalant of TSIs and UTPs |
| 13 |  Tests |
| 14 |  Test |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. | **[ ]**  | **[x]**  | **[ ]**  |
| **Prepared by :**  |  Yrd. Doç. Dr. Ömür AKBAYIR | **Date:** |  21.04.2016 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  505201506 | **TITLE** |  Business Economics |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   | x |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 1 | 20 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 50 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Business types and management approaches for engineers, production activities in enterprises, The marketing of manufactured products, types of cost that make up a product and calculation of these costs, manufacturing, sales, marketing, production, finance and accounting functions of the unit,Basic financial statements, regulation of financial records, Financial quality records, essential documents and records to account plan, Inventory records and amortization, Income and expense accounts, Asset and liability balance |
| **COURSE OBJECTIVES** |  To inform students about the basic level of management and accounting applications for engineers and inform business management. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  This course will operate in businesses that help students successfully complete the task in the middle and senior management positions to help them acquire basic business skills. |
| **LEARNING OUTCOMES OF THE COURSE** |  Business basic accounting concepts and be familiar with the subject. As sahiib about business functions with a holistic perspective to find out the operating management. knowledge on the regulation of financial records and documents have to be. |
| **TEXTBOOK** |  İşletme İktisadı. Prof. Dr. Tamer Müftüoğlu, İşletme Yöneticiliği. Prof. Dr. TAMER KOÇEL.  |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Basic Concepts of Business and with management |
| 3 |  Business objectives and the company's internal / external environment |
| 4 |  The functions of the business |
| 5 |  Breakeven point and income concepts |
| 6 | Midterm Examination 1 |
| 7 |  Basic types of cost |
| 8 |  Management of costs and the cost of forming a product |
| 9 |  Basic financial statements |
| 10 |  the regulation of financial records |
| 11 | Midterm Examination 2 |
| 12 |  Basic financial statements analysis methods |
| 13 |  Determination of investment and business value |
| 14 |  Case study |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. | **[ ]**  | **[x]**  | **[ ]**  |
| **Prepared by :**  |  Dr. Abdulhay TOLKUN | **Date:** |  27/05/2016 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  Strategic Management Accounting |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
| X |   |      |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 2 | 20 |
| Quiz |   |    |
| Homework | 2 | 20 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 60 |
| **PREREQUISITE(S)** |  - |
| **SHORT COURSE CONTENT** |  Basic topics in financial accounting and cost analysis, The role of accounting, Preparation and interpretation of financial information to be used in planning, evaluation and control of business resources, Strategic management and the role of accountant, Strategic cost management |
| **COURSE OBJECTIVES** |  The role of accounting in the development of effective strategies by governments and the approaches that can be used in appropriate system design. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Students who successfully complete this course will help them to acquire basic business skills that will help them to function as middle and top level managers in the businesses they will be active in. |
| **LEARNING OUTCOMES OF THE COURSE** |  To have knowledge about business and basic accounting concepts. Having knowledge about the accounting and financial analysis in the business with a holistic view with information about the functions of the operator. To obtain information on the regulation of financial records and documents. |
| **TEXTBOOK** |  Maliyet ve Yönetim Muhasebesi Uygulamaları Kitabı Prof. Dr. Yurdakul ÇALDAĞ, Sürdürülebilirlik ve Stratejik Yönetim Açısından Yönetim Muhasebesi Doç. Dr. Orhan Elmacı  |
| **OTHER REFERENCES** |  Finansal Yönetim Öztin Akgüç |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction |
| 2 |  Basic concepts in accounting and the functioning of accounting information system |
| 3 |  Examination of traditional management accounting issues |
| 4 |  Explanation of strategic management accounting concepts |
| 5 |  Cost analysis and cost management |
| 6 | Midterm Examination 1 |
| 7 |  Alternative choice decisions |
| 8 |  Strategic management and environmental analysis |
| 9 |  Strategic planning and operating budgets      |
| 10 |  Planning and Control in Strategic Management Accounting |
| 11 | Midterm Examination 2 |
| 12 |  Cash flow and resource requirements of businesses |
| 13 |  Profitability planning |
| 14 |  Financial reporting and evaluation |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Dr. Abdulhay TOLKUN | **Date:** |  21.11.2016 |

**Signature**:

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**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  DYNAMİCS OF RAİLWAY VEHİCLE SYSTEMS |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 20 |
| Quiz |   |    |
| Homework | 4 | 20 |
| Project | 1 | 30 |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 30 |
| **PREREQUISITE(S)** |  NONE |
| **SHORT COURSE CONTENT** |  Introduction to Dynamic Analysis, Numerical Methods to Find Response of Dynamic Systems, Introduction to Vehicle and Track Models, Solution of Geometrical, Normal and Tangential Problems due to Wheel-Rail Interaction, Investigation of Dynamic Response of a Wheelset, Investigation of Dynamic Response of a Railway Vehicle, Special Issues in Railway Vehicle Dynamics, Experimental Research for Railway Vehicles  |
| **COURSE OBJECTIVES** |  Aims of the course are acquainting attendants with various problems occuring due to wheel-rail interaction, teaching solution methods for these problems and dynamic analysis of railway vehicles. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Students, who complete this course, will have the ability to choose necessary system components for efficient vehicle design by interpreting the dynamic response of a railway vehicle  |
| **LEARNING OUTCOMES OF THE COURSE** |  Ability to solve problems occuring due to the wheel-rail interaction,Ability to analyze dynamic response of a wheelset and railway vehicle,Ability to make experimental research for railway vehicles |
| **TEXTBOOK** |  Garg, Vijay, and Dukkipati Rao V. Dynamics of railway vehicle systems. Academic Press, 1984.Shabana, Ahmed A., Khaled E. Zaazaa, and Hiroyuki Sugiyama. Railroad vehicle dynamics: a computational approach. CRC press, 2007.Knothe, Klaus, and Sebastian Stichel. Rail vehicle dynamics. Springer, 2017. |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction to Analysis of Dynamic Systems |
| 2 |  Response of Dynamic Systems Using Numerical Integration Methods |
| 3 |  Vehicle and Rail Models, Track Geometry and Solution to Geometrical Problem between Wheel-Rail |
| 4 |  Solution of Wheel-Rail Normal Problem |
| 5 |  Solution of Wheel-Rail Tangential Problem |
| 6 | Midterm Examination 1 |
| 7 |  Equations of Motion of a Wheelset on a Tangent Track      |
| 8 |  Equations of Motion of a Wheelset on a Tangent Track |
| 9 |  Dynamic Response of a Railway Vehicle on a Tangent Track |
| 10 |  Dynamic Response of a Railway Vehicle on a Tangent Track |
| 11 | Midterm Examination 2 |
| 12 |  Dynamic Response of a Railway Vehicle on a Curve |
| 13 |  Special Issues in Railway Vehicle Dynamics |
| 14 |  Experimental Research for Railway Vehicle Systems |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. | **[x]**  | **[ ]**  | **[ ]**  |
| **Prepared by :**  |  Prof.Dr. Abdurrahman Karamancıoğlu | **Date:** |  28/06/2017 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |        | **TITLE** |  INTRODUCTİON TO RAİLWAY-VEHİCLE AND TRACK INTERACTİON |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | Turkish/English |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 30 |
| Quiz |   |    |
| Homework | 4 | 30 |
| Project |   |    |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |  NONE |
| **SHORT COURSE CONTENT** |  Relationship of wheelset and track, charactheristics of wheel-rail contact geometry, vehicle run in a straight track, vehicle run through a curve, vehicles with tilting technology, vehicle guiding through a curve, safety verification against derailment, rail vehicle suspension system and mathemetical expressions of suspension elements.  |
| **COURSE OBJECTIVES** |  Aims of the course are acquainting attendants with various problems occuring due to wheel-rail interaction, creating mathematical expressions for the motions and forces induced as a result of rail-vehicle interaction, teaching solution methods for these problems and dynamic analysis of railway vehicles. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Students, who complete this course, will have the ability to derive expressions for the motion of rail vehicle, understand wheel track geometry and interaction, analysis of system components for efficient vehicle design by interpreting the dynamic response of a railway vehicle  |
| **LEARNING OUTCOMES OF THE COURSE** |  Ability to analyze physical phenomena occuring due to the wheel-rail interaction, Ability to analyze motion of a wheelset and railway vehicle,Ability to perfom analytical research for the design of railway vehicles |
| **TEXTBOOK** |  Jaromir Zelenka, Tomas Michalek, Theory of Vehicles, Jan Perner Transport Faculty, Pardubice 2014, ISBN: 978-80-7395-751-3. Garg, Vijay, and Dukkipati Rao V. Dynamics of railway vehicle systems. Academic Press, 1984. |
| **OTHER REFERENCES** |        |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Relationship of wheelset and track- Basic terms |
| 2 |  Charactheristics of wheel-rail contact geometry  |
| 3 |  Vehicle run in a straight track |
| 4 |  Motion of wheelset coupled to frame  |
| 5 |  Vehicle run through a curve  |
| 6 | Midterm Examination 1 |
| 7 |  Vehicles with tilting technology |
| 8 |  Vehicle guiding through a curve  |
| 9 |  Safety against derailment  |
| 10 |  Rail vehicle suspension  |
| 11 | Midterm Examination 2 |
| 12 |  Requirements on the suspension  |
| 13 |  Suspension elements  |
| 14 |  Theory of carbody suspension  |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. | **[ ]**  | **[ ]**  | **[x]**  |
| **Prepared by :**  |  Assist.Prof.Dr. İbrahim KOCABAŞ | **Date:** |  10.10.2017 |

**Signature**:

**T.R.**

**ESKISEHIR OSMANGAZI UNIVERSITY**

**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**COURSE INFORMATION FORM**

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| **DEPARTMENT** |  **RAIL SYSTEMS (MSc)** | **SEMESTER** |   |

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| **COURSE** |
| **CODE** |  5052 | **TITLE** |  DIAGNOSTICS AND MONITORING IN RAILWAY SYSTEMS  |

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| **LEVEL** | **HOUR/WEEK** | **Credit** | **ECTS** | **TYPE** | **LANGUAGE** |
| **Theory** | **Practice** | **Laboratory** |
|  **MSc** | 3  | 0  | 0  | 3  | 7,5 | COMPULSORY(   ) | ELECTIVE( x ) | TURKISH |
| **CREDIT DISTRIBUTION** |
| **Basic Science** | **Basic Engineering** | **Knowledge in the discipline****[if it contains considerable design content, mark with (√)]** |
|   |   |  3  |
| **ASSESSMENT CRITERIA** |
| **SEMESTER ACTIVITIES** | **Evaluation Type** | **Number** | **Contribution** **( % )** |
| Midterm | 1 | 20 |
| Quiz |   |    |
| Homework |   |    |
| Project | 1 | 40 |
| Report |   |    |
| Seminar |   |    |
| Other (     ) |   |    |
| **Final Examination** | 40 |
| **PREREQUISITE(S)** |        |
| **SHORT COURSE CONTENT** |  Concepts of Diagnostics and Prognostics, Mechanical Vibration, Preventive/Predictive Maintenance, Vibration Analysis, Transducers, Vibrodiagnostics, Acoustic Diagnostics, Model Based and Data Driven Methods, Stationary and Wayside Railway Vehicle Diagnosis, Wheel Defects and Detection, Bearing and Gearbox Fault Detection. Classification of Faults.  |
| **COURSE OBJECTIVES** |  To introduce vibration and acoustic based condition monitoring systems and signal analysis of rotating machinery; to develop an understanding in mechanical fault detection and diagnosis. |
| **COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION** |  Ability to understand how to use various sensors with their measurement principles in railway industry. Ability to model and simulate physical vibrations.  |
| **LEARNING OUTCOMES OF THE COURSE** |  1) Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines. 2) Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. 3) Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. 4) Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions.  |
| **TEXTBOOK** |  Czichos, H. (Ed.). (2013). Handbook of Technical Diagnostics. Berlin, Heidelberg: Springer Berlin Heidelberg. Tavner P., Ran L., Penman J., Sedding H. Condition monitoring of rotating electrical machines. London, U.K: Institution of Engineering and Technology, 2008.  |
| **OTHER REFERENCES** |  Ngigi, R. W., Pislaru, C., Ball, A., & Gu, F. (2012). Modern techniques for condition monitoring of railway vehicle dynamics. Journal of Physics: Conference Series, 364, 012016. Vinberg, E. M., Martin, M., Alfi Hadi Firdaus, Yihao Tang, & Alireza Qazizadeh. (2018). Railway Applications of Condition Monitoring.  |

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| **COURSE SCHEDULE (Weekly)** |
| **WEEK** | **TOPICS** |
| 1 |  Introduction  |
| 2 |  Basic Concepts of Diagnostics and Prognostics  |
| 3 |  Mechanical Vibration |
| 4 |  Industrial Sensors and Measurement Techniques; Transducers, Acoustic Sensors, Vibration Sensors  |
| 5 |  Fiber Bragg Grating (FBG) Sensors, Ultrasonic Sensors, Preventive and Predictive Maintenance  |
| 6 | Midterm Examination 1 |
| 7 |  Vibration Analysis, Vibrodiagnostics, Acoustic Diagnostics, Doppler Effect  |
| 8 |  Wheel Defects and Detection, Bearing and Gearbox Fault Detection |
| 9 |  Model Based and Data Driven Methods |
| 10 |  Fault Classification; Statistical Methods, Frequency Domain Methods |
| 11 | Midterm Examination 2 |
| 12 |  Stationary Methods in Railway Vehicle Diagnostics |
| 13 |  Modern Methods in Wayside Railway Vehicle Diagnostics |
| 14 |  Multi-fault Detection  |
| 15,16 | Final Examination |

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| **CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE RAIL SYSTEMS MSc PROGRAM LEARNING OUTCOMES** | **CONTRIBUTION LEVEL** |
| **NO** | **LEARNING OUTCOMES (MSc)**  | **3**High | **2**Mid | **1**Low |
| **LO 1** | Ability to access information in Rail Systems in a scientific manner in depth and in width as well as to assess, interpret and use the information obtained.  | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 2** | Detailed knowledge of the sate-of-the art techniques and methods applicable to the Rail Systems and their limitations.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 3** | Ability to deduce additional information from indefinite, limited or incomplete data using scientific methods and to put this information into practice as well as to incorporate data from different disciplines.  | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 4** | Awareness of the new and developing practices in Rail Systems and ability to study and learn such practices whenever needed. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 5** | Ability to recognize and formulate problems in Rail Systems and to develop methods to solve such problems utilizing innovative methods. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 6** | Ability to develop new or original ideas, to design complex systems or processes, and to come up with innovative/alternative solutions. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 7** | Ability to design and practice theoretical, experimental and simulative research tasks and to assess and analyze complex problems that are faces during the research process. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 8** | Ability to function effectively in multidisciplinary teams, to lead such teams and suggest solutions in such work environments; ability to work independently and take responsibility. | **[x]**  | **[ ]**  | **[ ]**  |
| **LO 9** | Ability to communicate in written and oral forms in a foreign language. | **[ ]**  | **[ ]**  | **[x]**  |
| **LO 10** | Ability to convey the method and results of the research in written or oral form to a national or international audience in the same field or in other fields in a clear and systematical way. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 11** | Knowledge of the social, environmental, health, safety and judicial dimensions of Rail Systems applications, knowledge of project management and workplace practices in the field as well as the awareness of limitations that such factors impose on the practices. | **[ ]**  | **[x]**  | **[ ]**  |
| **LO 12** | Awareness of societal, scientific and ethical values in collecting, interpreting, and publishing data and in other Professional activities. | **[ ]**  | **[x]**  | **[ ]**  |
| **Prepared by :**  |  Dr. Öür. Üy. Onur KILINÇ | **Date:** |  6 Kasım 2018 |

**Signature**: