**Minoufiya University,**

**Faculty of Engineering,**

**Electrical Eng. Dept.,**

**Post Graduate Studies and Research.**

**Minoufiya University**

Faculty of Engineering

**Course Specification**

***Title: Theories of Electrical Machines***

***Code Symbol: ELE 602***

***Department offering the course: Electrical Eng. Dept***

***Date of specification approval: / /2012***

***A- COURSE IDENTIFICATION AND INFORMATION:***

***B - Professional Information***

***B.1 Course Aims:***

This course aims to give the graduate a powerful tool to analyze and solve some

problems occurring in electrical machines. This course presents the main relevant theories

of electrical machines. It contains the generalized machine theory and its relationship with

the classical theory. It presents also the theory of symmetrical components and its

application in electrical machines.

***B.2 Course Objectives***

**1. Demonstration of the knowledge and understanding of the importance of theories of**

**electrical machines.**

**2. Definition of the requirements for the theories of electrical machines.**

**3. Determination of the machine parameter required for theories of electrical machine.**

**4. Obtaining the transient model of electrical machines.**

**5. Analyzing and performance of in induction motors during fault conditions.**

**6. Analyzing and calculating the short circuit current in synchronous machines from the**

**classical and general theories.**

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| Field | Programme ILOs that the  course contribute in achieving | Course ILOs |
| Knowledge&  Understanding | A1. Understand theory, basics  and practices of mathematics,  sciences and various electrical  power and machines  engineering technologies. | a1-1) Explain the application of Laplace  transform in transient analysis of electrical  machines and transformers. |
| A3. Understand the scientific  developments in electrical  power and machines  engineering. | a3-1) Choose the matrix analysis technique  for the analysis of electrical machines. |
| A5. Understand quality basics  for working in the power and  machines engineering field. | a5-1) Analyzing and calculating the  transient short circuit current of  synchronous machines.  a5-2) Analyzing the performance of  induction machines in case of phase  interruption. |
| Intellectual skills | B1. Analyze and evaluate the  data    and    use    it    to    solve  electrical power and machines  problems. | b1-1) Select the appropriate computer  programming    (MATLAB)    to    get    the  mathematical solution of the obtained  model.  b1-2) Select the appropriate method of  torque calculation. |
| B2. Produce solutions to power  and machines problems through  the    application    of    specific  engineering                   discipline  knowledge based on limited and  possible information. | b2-1) Select the appropriate solution (from  many solutions) for the problems based on  analytical thinking. |

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| Field | Academic Reference Standards For Electrical Engineering Postgraduates  (ARSEP-ELE) | | | |
| Knowledge &  Understanding | Intellectual  Skills | Professional  and Practical  Skills | General and Transferrable  Skills |
| Programme  Academic Standards  that the course  contribute in  achieving | A1, A3, A5 | B1,B2,B3 | C3,C4 | D1,D2,D3,D4,D5,D6,D7,D8 |



**7. Application of symmetrical component theory in the analysis of electrical machines in**

**both steady state and transient operations.**

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***B.3 Relationship between the course and the programme***

***B.4 Course Intended Learning Outcomes (ILOs)***

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|  | B3. Deal with different and  contradicting     knowledge     to  solve    power    and    machines  problems. | b3-1) Select the methods of solving some  problems occurring in electrical machines.  . |
| Professional and  Practical Skills | C3.    Evaluate    the    available  methods and tools in the power  and machines engineering field. | c3-1) Apply the computer programming  (MATLAB) to solve problems which are  not possible to be solved by hand. |
| C4. Define, plan, analyze, and  solve the power and machines  problems to reach conclusions  and compare the results with  others. | c4-1) Identify and formulate the problems  of electrical machines    from    real    life  situations, according to their priorities. |
| General and  Transferrable  Skills | D1. Communicate effectively in  writing, verbally and through  illustrations and mathematical  equations.  D2.         Apply         information  technology    tools    related    to  specific power and machines  discipline.  D3.    Evaluate    him-her     and  determine         his         personal  education needs.  D4. Use different resources to  obtain          knowledge          and  information.  D5. Put the rules and indicators  to evaluate performance of the  others.  D6. Work with a group and  manage the team.  D7.       Manage       the       time  efficiently.  D8.     Self     and     continuous  learning. | d1-1) Effective communication and sharing  ideas through solving tutorials.  d2-1) Apply the matrix technique and  Laplace transform all over the course.  d3-1) Measure his-her level by ordinary  investigations in regular times.  .d4-1) Use textbooks, and databases  information in lectures.  d5-1) Measure actual performance against  expected performance.  d6-1) communicate with a team work to  analyze certain problems occurring in  electrical machines and give a presentation.  d7-1) Apply monthly list of tasks that need  to be done  d8-1) Learn and practice something new  and different after the end of the course. |

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| Topic  No. | General Topics | Weeks |
| 1st | Winding inductances in electrical machines | 1 |
| 2nd | Linear transformation and (dq) model of electrical machines | 2 |
| 3rd | DC and AC series single phase commutator machines | 3 |
| 4th | The steady state performance of induction machines | 4 |
| 5th | Transient conditions in induction machines | 5 |



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***B.5 Course Topics.***

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| ***Week***  ***No.*** | ***Sub. Topics*** | ***Total***  ***Hours*** | ***Contact hrs*** | | | ***Course ILOs***  ***Covered (By No.)*** |
| **Lec.** | **Tut.** | **Lab.** |
| *Week-1* |     The objectives of the course      Definition of theories of electrical  machine.      Why this course is important?   Requirements of the course.   Winding inductance in electrical  machines | 6 | 4 | 2 | - | a1-1, a3-1, a5-1,  a5-2 |
| *Week-2* |     Linear transformation and       (dq)  model of electrical machines | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,  b3-1, c3-1, c4-1 |
| *Week-3* |     DC and AC series single phase  commutator machines. | 6 | 4 | 2 | - | a1-1, a3-1,b1-  1,b1-2,b2-1, b3-1,  c3-1, c4-1 |
| *Week-4* |     The steady state performance of  induction machines | 6 | 4 | 2 | - | a1-1, a3-1,b1-  1,b1-2,b2-1, b3-1,  c3-1 |
| *Week-5* |     Transient conditions in induction  machines. | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,  b3-1, c3-1 |
| *Week-6* |     The steady state performance of  synchronous machines. | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,  b3-1, c3-1, c4-1 |
| *Week-7* |     Transient conditions in synchronous  machines | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,  b3-1, c3-1, c4-1 |
| *Week-8* |     Presentation about*"Small*  *oscillations in separately excited dc*  *machines"* | 6 | 4 | 2 | - | d6-1, d3-1, d5-1,  d6-1, d71, d-1 |
| *Week-9* |     Theory of steady state and transient  symmetrical components | 6 | 4 | 2 | - | a1-1, a3-1,b1-  1,b1-2,b2-1, b3-1,  c3-1 |

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| 6th | The steady state performance of synchronous machines. | 6 |
| 7th | Transient conditions in synchronous machines | 7 |
| 8th | Theory of steady state and transient symmetrical components | 8 |
| 9th | Application of symmetrical components in balanced polyphase induction  machines | 9 |
| 10th | Application of symmetrical components in unbalanced two phase induction  machines | 10 |
| 11th | Single phase operation of induction machines | 11 |
| 12th | The polyphase synchronous machines with uniform air gap and no damper  windings | 12 |
| 13th | The polyphase synchronous machines with salient poles and no damper  windings | 13 |



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***B.6 Course Topics/hours/ILOS***

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| **Course Intended**  **learning outcomes**  **(ILOs)** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Knowledge &**  **understanding** | **a1-1** | **x** |  | **x** |  | **x** | **x** |  |  |  |  |  |  |  |
| **a3-1** | **x** |  | **x** |  | **x** | **x** |  |  |  |  |  |  |  |
| **a5-1** | **x** |  | **x** |  | **x** | **x** |  |  |  |  |  |  |  |
| **a5-2** | **x** |  | **x** |  | **x** | **x** |  |  |  |  |  |  |  |
| **Intellectual**  **Skills** | **b1-1** | **x** |  | **x** | **x** | **x** | **x** |  |  |  |  |  |  |  |
| **b1-2** | **x** |  | **x** | **x** | **x** | **x** |  |  |  |  |  |  |  |
| **b2-1** | **x** |  | **x** | **x** | **x** | **x** |  |  |  |  |  |  |  |
| **b3-1** | **x** |  | **x** | **x** | **x** | **x** |  |  |  |  |  |  |  |
| **Professional**  **and practical**  **Skills** | **c3-1** | **x** |  | **x** | **x** | **x** | **x** |  |  |  |  |  |  |  |
| **c4-1** | **x** |  | **x** | **x** | **x** | **x** |  |  |  |  |  |  |  |
| **General and**  **Transferrable**  **Skills** | **d1-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |
| **d2-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |
| **d3-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |
| **d4-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |
| **d5-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |
| **d6-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |
| **d7-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |
| **d8-1** | **x** | **x** | **x** |  | **x** | **x** | **x** |  | **x** | **x** |  |  |  |

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| *Week-*  *10* |     Application         of         symmetrical  components in balanced polyphase  induction machines | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,  b3-1, c3-1 |
| *Week-*  *11* |     Application         of         symmetrical  components    in    unbalanced    two  phase induction machines | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,  b3-1, c3-1 |
| *Week-*  *12* |     Single phase operation of induction  machines | 6 | 4 | 2 | - | a1-1, a3-1,b1-  1,b1-2,b2-1, b3-1,  c3-1 |
| *Week-*  *13* |     The    poly    -    phase    synchronous  machines with uniform air gap and  no damper windings |  |  |  |  | a1-1, a3-1,b1-  1,b1-2,b2-1, b3-1,  c3-1 |
| *Week-*  *14* |     The         polyphase         synchronous  machines with salient poles and no  damper windings |  |  |  |  | a1-1, a3-1,b1-  1,b1-2,b2-1, b3-1,  c3-1, c4-1 |
|  |     Presentation          about*"Small*  *oscillations in balanced induction*  *machinmes"* |  |  |  |  | d6-1, d3-1, d5-1,  d6-1, d71, d-1 |



**B.7*Teaching and Learning Method:***

**Presentation**

**andMovies**

**Selflearning**

**Cooperative**

**Discovering**

**Discussion**

**Modelling**

**Sitevisits**

**Problem**

**solving**

**Brain**

**storming**

**Tutorial**

**Projects**

**Lecture**

**Playing**

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| **Assessment Method** | **Mark** | **Percentage** |
| **Final Examination (*written*)** | **100** | **100%** |
| **Total** | **100** | **100%** |



**B. 8*Assessments:***

***B.9 Facilities required for teaching and learning:***

***Weighting of assessments:***

**A. Library Usage:** Students should be encouraged to use library technical resources in the

preparation of reports.

***B.10 List of references:***

1- Course notes (updated yearly).

2- Dr P. S. Bimbhra "Generalized Theory of Electrical Machines" 5th edition, 2nd reprint,

Khanna Publishers, Delhi, India, 1997.

3- N. N. Hancock "Matrix Analysis of Electrical Machinery" 2nd edition, Pergamon Press Lid.,

Toronto, Canada, 1974.

4- Periodicals, web sites.

5- G. J. Retter "Matrix and Space – Phasor Theory of Electrical Machines" Akademiai Kiado,

Budapest, Hungary, 1987.

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**Course Coordinators** **Head of Department**

**Prof. Dr. Fathy Abdel-kader** **Prof. Dr. Gamal Morsi**

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