**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.**

1/ELE 602

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| Field | Programme ILOs that thecourse contribute in achieving | Course ILOs |
| Knowledge&Understanding | A1. Understand theory, basicsand practices of mathematics,sciences and various electricalpower and machinesengineering technologies. | a1-1) Explain the application of Laplacetransform in transient analysis of electricalmachines and transformers. |
| A3. Understand the scientificdevelopments in electricalpower and machinesengineering. | a3-1) Choose the matrix analysis techniquefor the analysis of electrical machines. |
| A5. Understand quality basicsfor working in the power andmachines engineering field. | a5-1) Analyzing and calculating thetransient short circuit current ofsynchronous machines.a5-2) Analyzing the performance ofinduction machines in case of phaseinterruption. |
| Intellectual skills | B1. Analyze and evaluate thedata    and    use    it    to    solveelectrical power and machinesproblems. | b1-1) Select the appropriate computerprogramming    (MATLAB)    to    get    themathematical solution of the obtainedmodel.b1-2) Select the appropriate method oftorque calculation. |
| B2. Produce solutions to powerand machines problems throughthe    application    of    specificengineering                   disciplineknowledge based on limited andpossible information. | b2-1) Select the appropriate solution (frommany solutions) for the problems based onanalytical thinking. |

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| Field | Academic Reference Standards For Electrical Engineering Postgraduates(ARSEP-ELE) |
| Knowledge &Understanding | IntellectualSkills | Professionaland PracticalSkills | General and TransferrableSkills |
| ProgrammeAcademic Standardsthat the coursecontribute inachieving | 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)***

2/ELE 602

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|  | B3. Deal with different andcontradicting     knowledge     tosolve    power    and    machinesproblems. | b3-1) Select the methods of solving someproblems occurring in electrical machines.. |
| Professional andPractical Skills | C3.    Evaluate    the    availablemethods and tools in the powerand machines engineering field. | c3-1) Apply the computer programming(MATLAB) to solve problems which arenot possible to be solved by hand. |
| C4. Define, plan, analyze, andsolve the power and machinesproblems to reach conclusionsand compare the results withothers. | c4-1) Identify and formulate the problemsof electrical machines    from    real    lifesituations, according to their priorities. |
| General andTransferrableSkills | D1. Communicate effectively inwriting, verbally and throughillustrations and mathematicalequations.D2.         Apply         informationtechnology    tools    related    tospecific power and machinesdiscipline.D3.    Evaluate    him-her     anddetermine         his         personaleducation needs.D4. Use different resources toobtain          knowledge          andinformation.D5. Put the rules and indicatorsto evaluate performance of theothers.D6. Work with a group andmanage the team.D7.       Manage       the       timeefficiently.D8.     Self     and     continuouslearning. | d1-1) Effective communication and sharingideas through solving tutorials.d2-1) Apply the matrix technique andLaplace transform all over the course.d3-1) Measure his-her level by ordinaryinvestigations in regular times..d4-1) Use textbooks, and databasesinformation in lectures.d5-1) Measure actual performance againstexpected performance.d6-1) communicate with a team work toanalyze certain problems occurring inelectrical machines and give a presentation.d7-1) Apply monthly list of tasks that needto be doned8-1) Learn and practice something newand different after the end of the course. |

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| TopicNo. | 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 |



3/ELE 602

***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 electricalmachine.    Why this course is important? Requirements of the course. Winding inductance in electricalmachines | 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 phasecommutator 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 ofinduction machines | 6 | 4 | 2 | - | a1-1, a3-1,b1-1,b1-2,b2-1, b3-1,c3-1 |
| *Week-5* |     Transient conditions in inductionmachines. | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,b3-1, c3-1 |
| *Week-6* |     The steady state performance ofsynchronous machines. | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,b3-1, c3-1, c4-1 |
| *Week-7* |     Transient conditions in synchronousmachines | 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 transientsymmetrical 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 inductionmachines | 9 |
| 10th | Application of symmetrical components in unbalanced two phase inductionmachines | 10 |
| 11th | Single phase operation of induction machines | 11 |
| 12th | The polyphase synchronous machines with uniform air gap and no damperwindings | 12 |
| 13th | The polyphase synchronous machines with salient poles and no damperwindings | 13 |



4/ELE 602

***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         symmetricalcomponents in balanced polyphaseinduction machines | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,b3-1, c3-1 |
| *Week-**11* |     Application         of         symmetricalcomponents    in    unbalanced    twophase induction machines | 6 | 4 | 2 | - | b1-1,b1-2,b2-1,b3-1, c3-1 |
| *Week-**12* |     Single phase operation of inductionmachines | 6 | 4 | 2 | - | a1-1, a3-1,b1-1,b1-2,b2-1, b3-1,c3-1 |
| *Week-**13* |     The    poly    -    phase    synchronousmachines with uniform air gap andno damper windings |  |  |  |  | a1-1, a3-1,b1-1,b1-2,b2-1, b3-1,c3-1 |
| *Week-**14* |     The         polyphase         synchronousmachines with salient poles and nodamper 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**

5/ELE 602

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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**

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**Date:**