1. **Course Number and Course Title:**
   COE 59408 – Cognitive Robotics

2. **Credit Hours:**
   3-0-3

3. **Prerequisites and/or Co-Requisites:**
   Prerequisite: Approval of Program Director
   Co-requisites: None
   Competencies: Knowledge of programming (equivalent to CMP 220 or better).

4. **Name and Contact Information of Instructor:**
   Dr. Michel Pasquier

5. **Course Description (Catalog Description):**
   Introduces the fundamental concepts and algorithms of cognitive robotics. Studies cognitive functions and architectures, from biological inspiration to computational models, and their embedding on robotic platforms. Covers perception, computation, and action in the physical world, as applied to localization, mapping, manipulation, and motion planning. Examines selected advanced topics such as approximate reasoning, autonomous exploration, social cognition, and cognitive systems for smart cities.

6. **Textbook and other Supplemental Material:**
   Textbook:
   - N. Correll, *Introduction to Autonomous Robots,* Magellan Scientific, 2016.

   Other recommended texbooks:
   - D. Vernon, *Artificial Cognitive Systems: A Primer,* MIT Press, 2014.
   - R. Murphy, *Introduction to AI Robotics,* 2nd ed., MIT Press, 2018.
   - R. Seigwart and I.R. Nourbakhsh, *Introduction to Autonomous Mobile Robots,* 2nd ed., MIT Press, 2011.
   - G. Bekey, *Autonomous Robots: From Biological Inspiration to Implementation and Control,* MIT Press, 2005.

   Supplemental material:
   - R. Pfeifer and J. Bongard, *How the Body Shapes the Way We Think: A New View of Intelligence,* MIT Press, 2007.
   - R.F. Stengel, *Robotics and Intelligent Systems: A Virtual Reference Book,* Princeton University, 2017 [online].
   - Selected articles and journal papers, simulation tools and data.

7. **Course Learning Outcomes:**
   Upon completion of the course, students will be able to:
   1. Appraise the growing importance of cognitive robots in human society.
   2. Compare cognitive functions and architectures for cognitive robotics.

3. Model perception using various sensors and data processing techniques.
4. Apply state estimation models then localization and mapping methods.
5. Combine manipulation and motion planning concepts to solve robot tasks.
6. Analyze selected issues in cognitive robotics such as approximate reasoning.
7. Employ state-of-the-art software tools to program autonomous robots.

8. Teaching and Learning Methodologies:

Methods include lectures, problem and project based learning methods (assignments, exams, survey paper, research project, presentation), and class discussions.

9. Course Topics and Schedule:

Topic	**Weeks**
Introduction to cognitive autonomous robots	1
Cognitive robot architectures, hierarchies, subsumption	1
Behavioral control, reactive control, hybrid control	1.5
Locomotion, forward and inverse kinematics	1
Sensors (range finders, GPS, IMU) and sensor fusion	1.5
Vision, feature extraction, object and place recognition	1.5
State estimation, localization, and mapping	1.5
Manipulation and dexterous grasping	1
Path planning and collision avoidance	2
Selected topics: approximate reasoning, exploration, social cognition	2
Review and Evaluation	2
Total:	**16**