UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	ELECTRICAL ENGINEERING
SUBJECT	DYNAMIC AND CONTROL OF POWER SYSTEMS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50363-Ingegneria elettrica
CODE	22262
SCIENTIFIC SECTOR(S)	ING-IND/33
HEAD PROFESSOR(S)	MUSCA ROSSANO Ricercatore a tempo determinato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**MUSCA ROSSANO** Tuesday 12:00 13:00

DOCENTE: Prof. ROSSANO MUSCA

PREREQUISITES	Basic skills of math, physics, circuit theory, and power systems.
LEARNING OUTCOMES	KNOWLEDGE AND UNDERSTANDING The student will know the scientific language typically related to dynamics and control of electric power systems. The student will be able to understand the problems related to the dynamic operation of the electric system, and to identify the most appropriate approach and methodologies for the analysis of each specific problem. To achieve these objectives, the course will include lectures, guided exercises with specialized software and discussion of case studies. The verification of these objectives is expected within the final exam. APPLYING KNOWLEDGE AND UNDERSTANDING The student will be able to apply its engineering knowledge to analyze power systems in the different dynamic operating conditions, and then to solve the problems related to them. To achieve these objectives, the course will include lectures, guided exercises with specialized software and discussion of case studies. The verification of these objectives is expected within the final exam, including the discussion on the exercises book that each student presents. AUTONOMY OF JUDGEMENT The student will have independent judgment with regard to the understanding of the aspects related to the dynamics and the control of complex power systems. To achieve these objectives, the course will include lectures, guided exercises with specialized software and discussion of case studies. The verification of these objectives is expected within the final exam, including the discussion on the exercises book that each student presents. COMMUNICATION SKILLS The student will be able to communicate with competence and property of language the issues related to the topics covered by the course, as well as to speak profitably on these topics with specialists from other branches of engineering, outlining the basic problems and illustrating the adopted methodologies and solutions. To achieve these objectives, the course will include lectures, guided exercises with specialized software and discussion of case studies. The verification of these objectives is expected within the final oral exam. LEARNING ABILITY The student will acquire the necessary skills to manage independently definition, study, and analysis of power systems dynamics. In particular, the student will learn how to classify the dynamic phenomena within power systems, choose the most appropriate methodology and tools for the analysis of the problem, and define the possible solutions in terms of control and operating conditions of the power system. To achieve these objectives, the course will include lectures, guided exercises with specialized software and discussion of case studies. The verification of these objectives is expected within the final oral exam.
ASSESSMENT METHODS	The assessment of the acquired skills is done during an oral exam including the correction of the exercises collected in the exercise book. The final exam looks at: - the degree of knowledge and understanding of course programme; - the ability to apply the gained knowledge for the analysis and the solution of problems related to the course and the corresponding contexts, proving competence, consistency, effectiveness and autonomy of judgment; - the ability to reprocess the acquired knowledge and skills by identifying disciplinary and interdisciplinary links; - the communication skill, with particular attention to clarity and property of language. The oral exam concerns the presentation of different topics addressed in the course. During the oral exam, a few questions on the resolution of at least one exercise like those applied in the classroom and reported on the exercise book will also formulated. The final assessment will be based on both the written and the oral exam, will be properly graded, and will be formulated on the basis of the following conditions: a) sufficient knowledge of the topics and the concepts addressed in the course; sufficient degree of awareness and autonomy in the application of the theories to solve problems (18-21 grade); b) good knowledge of the topics and the concepts addressed in the course; fair degree of awareness and autonomy in the application of the theories to solve problems (22-25 grade); c) good knowledge of the topics and the concepts addressed in the course; good degree of awareness and autonomy in the application of the theories to solve problems (26-28 grade); d) excellent knowledge of the topics and the concepts addressed in the course; excellent level of awareness and autonomy in the application of the theories to solve problems (29-30L grade).
EDUCATIONAL OBJECTIVES	The educational objectives consist in the acquisition of the skills related to dynamic stability and control of power systems, typically subject of the activity of the senior engineers in the electrical engineering field: a) activities based on the application of the concepts for the analysis and the understanding of the dynamic phenomena in power systems; b) implementation and simulation of mathematical models of the different elements of power systems, for the analysis of the transient phenomena within different time domains; c) understanding and application of the typical methodologies of analysis of the dynamic characteristics of power systems, such as the modal analysis or small-signal stability, the frequency scanning, the transient stability, the oscillatory stability. In addition, a further objective is the development of the awareness about the need of a continuous and autonomous study during the entire professional activity, related to the constant evolution of electric power systems

	and to the challenges to address in terms of system's dynamic stability and control.
TEACHING METHODS	Lectures, workshops, and exercises
SUGGESTED BIBLIOGRAPHY	"Power System Stability and Control", P. Kundur; "Power Systems Electromagnetic Transients Simulation", N. Watson, J. Arrillaga; "Power System Control and Stability", P.M. Anderson, A.A. Fouad; Dispense del docente.

SYLLABUS

Hrs	Frontal teaching
3	Introduction; Definitions; Classification of the dynamic phenomena in power systems; Scope of applications; Methodologies for digital simulation
2	Modeling of continuous and discrete dynamic systems
5	Modelling of synchronous machines and primary control systems
1	Modelling of transformers
3	Modelling of lines and cables
2	Modelling of loads
5	Modelling of sources interfaced through power electronics, FACTS and HVDC
2	Modelling of power system and network equations
2	Simulation – Fundamentals of numerical methods
1	Simulation – Initialization and steady-state conditions
3	Simulation – Modal analysis and small-signal stability
3	Simulation – Oscillatory stability
3	Simulation – Transient stability
5	Simulation – Electromagnetic transients
2	Simulation – Impedance analysis and frequency scanning
1	Simulation – Elements of hybrid and real-time simulations

Hrs	Practice
11	Exercises