

Sana'a University
Faculty of Engineering
Department: Electrical Engineering



Master of Science in
Communications
And Networks Engineering

Program
Specifications

June - 2021

Faculty of Engineering, Sana'a University

University of Sana'a
 Faculty of Engineering
 Department: Electrical Engineering
 Title of the Program:
 Master of Science in Communications
 and Networks Engineering



Program Specification

1. Program Introduction/Description

The Department offers a graduate program leading to the M.Sc. degree in Communications and Networks Engineering. The program provides advanced instruction and research opportunities in a broad range of Communication Systems and Networks Engineering areas and is focused on both the theoretical and practical aspects of the state-of-the-art in Communications and Networking Engineering. The program has been designed to equip students with both the systematic knowledge and the essential training towards engineering design and independent research in the field of Communication Systems and Networks Engineering.

2. Program Identification and General Information

Program Title	Master of Science in Communications and Networks Engineering
Awarding Institution	Sana'a University
Department	Department of Electrical Engineering
Other Departments with major Teaching Contributions	None
Language of study	English Language
Date of Specification Preparation/Revision	May 2021
Mode of Study	Full time
Study System	Courses & Thesis
Main Location of Study	Faculty of Engineering/Sana'a University
Mode of Delivery	Full-time
Study Duration	Minimum: 2 Academic years (Two terms each, full-time) Maximum: 3 Academic years (two terms each - full time)
Award(s) or Final Award	Master of Science (MSc.) in Communications and Networks Engineering
Qualification required to join the program:	BSc. in Electrical Engineering and/or related fields
Minimum grade requirements to enroll in the program	Good
Other admission requirements	Detailed below
Name of the program coordinator	Associate Prof. Mohammed Abdo Al-Mekhlafi
Approval date:	

Head of the Department Dr. Adel Ahmed Al-Shokairi	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Al_Gorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad
Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas			

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3. Program Curriculum Committee:

Dr. Mohammed Al-Mekhlafi	Dr. Abdulkafi Al-Eriany
Dr. Mohammed Al-Gorafi	Dr. Adel Al-Shokairi
Dr. Ali Manea	Dr. Mohammed Hankal
Dr. Radwan Al-Bothigi	Dr. Mohammed Abdul Karim Al-Suraby
Dr. Farook Al-Fohiadi	Dr. Nasser Al-Mofari
Dr. Ali Nagi Nasary	

4. Vision, Mission & Aims of the University

Vision of the University

Sana'a University aspires to achieve a national leading role in teaching, learning, scientific research and community service; and to be among the best regional universities and the foremost house of expertise and think tank in Yemen.

Mission of the University

To contribute to the sustainable development efforts by providing an accredited higher education environment and excellent research services within a fruitful national partnership based on transparency, professionalism and creativity.

Aims of the University

The University seeks to achieve the following objectives:

To provide specialized and in-depth academic opportunities for students in different fields of knowledge to meet the country's needs of specialties, technicians and experts, with special focus on the following:

1. To boost the level and quality of preparation and qualification tasks.
2. To create a general culture aiming at developing the elements of sound Islamic personality and the proper cognitive and scientific training.
3. To stabilize the true Islamic vision emanating from the broad horizons of Islamic knowledge and its perception of the universe, man and life.
4. To develop innovative and critical scientific thinking skills.
5. To provide students with the required knowledge and scientific and applied skills for solving problems effectively and efficiently.

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Rector of Sana'a University			
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5. Vision, Mission & Aims of the Faculty

Vision of the Faculty

To excel in engineering education & scientific research with distinction at the local and regional levels.

Mission of the Faculty

To provide excellent and accredited engineering education to meet the development needs and match the labor market requirements locally and regionally.

Aims of the Faculty

1. To offer study programs in various fields of knowledge and equip students with required knowledge and scientific and know-how skills to utilize them in resolving problems effectively and efficiently.
2. To develop positive trends towards engineering science and its accelerating developments and enable students to use the techniques and methods of conducting scientific research in engineering fields.
3. To develop skills of scientific, innovative and critical thinking as well as the concept of continuous self-education.
4. To strengthen scientific ties with national and international colleges, scientific bodies, and research & development centers.
5. To provide technical and specialized studies and consultations to various state bodies and institutions, both public and semi-public, and utilize them in resolving the environment and society issues to promote sustainable development.
6. To develop a spirit of co-operation, group work, effective leadership, sense of responsibility, and ethical commitment.

6. Mission & Aims of the Department

Mission of the Department

Graduate qualified Engineers in Electric Power, Communication and Computer Engineering in accordance with programs committed to the international quality standards. The Graduating Engineers handed with enough knowledge and skills necessary to meet the requirements of development as well as local and regional labor markets. Also, they able to self-development and proceed with contemporary issues. The department contribute to community wellness and the country development through scientific research, advisory services, and training and education

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6. Mission & Aims of the Department

programs.

Aims of the Department

1. Graduate high qualified engineers in Electrical Power, Communication and Computer Engineering able to compete at national and regional levels.
2. Update undergraduate and post graduate programs and enhance the applied research environment to contribute in country development.
3. Establish partnerships with the public and private sectors and provide engineering consultancies, continuous training, teaching and awareness programs.
4. Improve the academic staff to student ratio as per standard.
5. Fill the gap in the number of assistance staff and laboratory technicians and implement training programs to enhance their skills.
6. Commit and uphold high ethical and professional conduct in the education and practice of engineering.

7. Mission & Aims of the Program

Mission of the Program

- To advance knowledge and educate engineers who will make the world a better place by using the power of engineering principles, techniques and systems.
- To focus on equipping engineers with the state-of-art knowledge and skills they need for work and for life.
- To empower practicing engineers with the state-of-art technology to meet the growing challenges of the industry.
- To carry out research through constant interaction with research organizations and industry.

Aims of the Program

This program will provide students with opportunities to:

1. Develop advanced knowledge and broad understanding of the principles and methodologies of communications and networks engineering.
2. Apply their knowledge to design, investigate and solve complex problems in the areas of

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7. Mission & Aims of the Program

- communication systems and networking.
- Promote scientific and applied research particularly that is related to development local Telecommunications companies.
 - Develop their independent learning skills as required for continued professional development,
 - Develop high-level oral and written communication skills specific to the needs of the communication systems industry and network engineering.

8. Program Standards & Benchmarks

Program Standards

- UK Higher Education Programs Accreditation, the Institution of Engineering and Technology (IET).
- The Quality Assurance Agency (QAA) Subject Benchmark Statement: Engineering, Feb 2015.
- The QAA Framework for Higher Education Qualifications, October 2019.
- The ASIIN, a well-respected German quality assurance institution.
- The Engineering Accreditation Commission of ABET.
- The Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), USA.

Program Benchmarks

Name of Program	The University	The Country
1. MSc. Communication Systems and Networks	TH Koln – University of Applied Sciences	Germany
2. MSc Mobile Communications and Smart Networking	University of Southampton	UK
3. MSc. Telecommunication Engineering	Universidad Politécnic de Madrid (UPM)	Spain
MSc. Telecommunications and Networks Engineering	University of Bahrain	Kingdom of Bahrain
4. MSc. Telecommunications Engineering	The University of Texas at Dallas	USA
5. MSc Telecommunication Engineering	King Fahd University of Petroleum and Minerals (KFUPM)	KSA

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9. Summary of Similar Programs (Benchmarks) for Communications and Networks Engineering Program

	The Similar Programs (Benchmarks)						Current Program
	1 st Program	2 nd Program	3 rd Program	4 th Program	5 th Program	6 th Program	
Program Title	MSc. Communication Systems and Networks	MSc. Mobile Communications and Smart Networking	MSc. Telecommunication Engineering	MSc. Telecommunications and Networks Engineering	MSc. Telecommunications Engineering	MSc. Telecommunication Engineering	MSc. Communications and Networks Engineering
Faculty	Faculty of Information, Media and Electrical Engineering	Faculty of Engineering and Physical Sciences	Information and Communication Technologies	College of Engineering	Erik Jonsson School of Engineering and Computer Science	College of Engineering and Applied Engineering	Faculty of Engineering
University	TH Koln – University of Applied Sciences	University of Southampton	Universidad Politécnica de Madrid (UPM)	University of Bahrain	The University of Texas at Dallas	King Fahd University of Petroleum and Minerals (KFUPM)	University of Sana'a
Country	Germany	UK	Spain	Kingdom of Bahrain	USA	KSA	Yemen
Type of Program	Coursework and Thesis	Coursework and Research Project	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis
Study methods in the program	Full-time	Full-time	Full-time	Full-time	Full-time	Full-time	Full-time
Number of semesters	3 semesters	3 semesters	4 semesters (Two years)	4 semesters (Two years)	4 semesters (Two years)	4 semesters (Two years)	4 semesters (Two years)

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9. Summary of Similar Programs (Benchmarks) for Communications and Networks Engineering Program

							years)
Total Credit Hours (without Thesis)	63 ECTS points *	60 ECTS (120 CATS)	90 ECTS	24 CH	33 CH	24 CH	30 CH
No. of Compulsory Courses	9	5 modules	12	6	5	5	8
Credit Hours for Compulsory Courses	48 ECTS points	37.5 ECTS (75 CATS)	60 ECTS	24 CH	15 CH	15 CH	24 CH
No. of Elective Courses	3	3 modules	6	—	4	3	2
Credit Hours for Elective Courses	15 ECTS	22.5 ECTS (45 CATS)	30 ECTS	—	12 CH	9 CH	6
Complementary courses to join the program and their number	—	—	—	—	—	—	4 (Not Credited)
Credit Hours for Thesis	27 ECTS	30 ECTS (60 CATS)	30 ECTS	12 CH	6 CH	6 CH	6 CH
Total Credit	90 ECTS credit	90 ECTS (180)	120 ECTS	36 CH	33 CH	30 CH	36 CH

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9. Summary of Similar Programs (Benchmarks) for Communications and Networks Engineering Program

Hours for courses & Thesis	points	CATS)					
The period for thesis completion	1 Semester	1 Semester	1 Year	1 Year	1 Semester	1 year	1 year
The min. period to complete the program	3 Semesters	3 Semesters	2 Years	2 Years	2 Years	2 Years	2 Years
The max. period to complete the program	N/A	N/A	N/A	N/A	N/A	2.5 years	3 + 1 Years

* European Credit Transfer System (ECTS). Note that 2 ECTS = 1 US credit hour.

10. Program Intended Learning Outcomes (PILOs)

A. Knowledge and Understanding
 Upon successful completion of the Master of Science in Communications and Networks Engineering Program, graduates should be able to:

A1.	Demonstrate advanced knowledge and understanding of mathematical methods, scientific and engineering principles, and engineering specialization relevant to communication systems and network engineering.
A2.	Develop an understanding of the contemporary technical and professional issues in engineering.
A3.	Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic,

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10. Program Intended Learning Outcomes (PILOs)	
	environmental, and societal contexts.
A4.	Acquire and apply new knowledge as needed, using appropriate learning skills and strategies.
B. Intellectual Skills	
Upon successful completion of the Master of Science in Communications and Networks Engineering Program, graduates should be able to:	
B1.	Model and simulate the behavior of wireless communication channels, transmitters, and receivers.
B2.	Critically analyze and compare the performance and complexity of various technical options for mobile communication systems and networks.
B3.	Identify, formulate, and solve complex engineering problems in communication systems and networks by using appropriate techniques, technologies and/or tools.
B4.	Investigate and critically evaluate current research and literature review related to specialized areas of communications and networks, industrial documentation, standards, analyze and interpret data, and use engineering judgment to draw conclusions.
C. Practical and Professional Skills	
Upon successful completion of the Master of Science in Communications and Networks Engineering Program, graduates should be able to:	
C1.	Apply appropriate mathematical and computer-based methods for modeling and analyzing discipline-specific engineering problems.
C2.	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
C3.	Apply alternative methods for solving engineering problems and identify advantages and disadvantages of the alternative methods.
C4.	Conduct research independently and collaboratively, and produce technical reports, a master thesis, and scientific technical papers.

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10. Program Intended Learning Outcomes (PILOs)

D. Transferrable Skills

Upon successful completion of the Master of Science in Communications and Networks Engineering Program, graduates should be able to:

D1.	Apply engineering techniques, skills, and modern engineering tools in problem solving, and make competent decisions in complex and unpredictable situations.
D2.	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
D3.	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
D4.	Communicate technical information orally, visually, in writing, and in drawings using professional media with clear and concise arguments.

11. Teaching Strategy to Achieve Program Learning Outcomes

ILOs	Teaching Strategy	Assessment Methods
A1.	Lectures, directed reading, self-learning, problem solving, discussions, individual projects, supervision of projects.	Written Exams, problem solving exercises, written reports, oral presentations, coursework and the dissertation.
A2.	Learner-centered, self-learning, active learning, individual project, computer hands-on sessions.	Written Exams, Assignments, Experimental work, laboratory report, and survey.
A3.	Lectures, Seminars, Self-Learning, Discussions, active learning, computer hands-on sessions.	Written Exams, Assignments, Experimental work, laboratory report, and survey.
A4.	Lectures, simulation exercises, coursework, design projects, individual research projects, Seminars, Self-Learning, Discussions, active learning, Brain storming, computer hands-on sessions.	Written Exams, Assignments, report, oral presentation and dissertation.
B1.	Lectures, Computer hands-on sessions. coursework, design projects, individual research projects, Project supervision, independent study, Problem Solving, Brain storming, Presenting researches	Written Exams, Assignments, coursework reports, and Presenting researches, dissertation, and literature survey.

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ILOs	Teaching Strategy	Assessment Methods
B2.	Project supervision, laboratory works, Self-Learning, simulation exercises, independent study, Analysis and Problem Solving, Lectures, Brain storming, Presentations, Presenting researches	Assignments, coursework reports, Presenting researches, dissertation, and literature survey.
B3.	Individual project, Project supervision, Self-Learning, simulation exercises, independent study, Analysis and Problem Solving, Lectures, Brain storming, Presentations, Presenting researches	Assignments, coursework reports, Presenting researches, dissertation, and literature survey.
B4.	Coursework, group-based learning, group-work, oral presentation and dissertation	Assignments, coursework reports, Presenting researches, dissertation, and literature survey.
C1.	Project supervision, directed reading independent study, simulation exercises, Analysis and Problem Solving	Assignments, coursework reports, Presenting researches, dissertation, and literature survey.
C2.	Project supervision, group design projects, presentation lectures, laboratory works, independent study, simulation exercises, Analysis and Problem Solving	Assignments, coursework reports, Presenting researches, dissertation, and literature survey.
C3.	Project supervision, lectures, laboratory works, independent study, simulation exercises, Analysis and Problem Solving	Assignments, coursework reports, Presenting researches, dissertation, and literature survey.
C4.	Independent research, project management, and report writing, discussion.	Assignments, coursework reports, Presenting researches, dissertation, and literature survey.
D1.	Dissertation and presentation, independent study, Presenting reports, Brainstorming, Presenting researches, Publish research papers.	Written research proposal, thesis and publication, Written Exam, Assignments, survey, presentation, written report.
D2.	Dissertation and presentation, independent projects, Presenting reports, Brainstorming, Presenting researches, Publish research papers.	Written research proposal, thesis, publications, Assignments, presentation, written report, course work, and dissertation.
D3.	Dissertation and presentation, independent projects,	Written research proposal, thesis and

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ILOs	Teaching Strategy	Assessment Methods
	Presenting reports, Brainstorming, Presenting researches, Publish research papers.	publication, Written Exam, Assignments, Experimental and field work, laboratory report, survey, presentation, written report.
D4.	Coursework and project work, presentation, oral discussions	Coursework and the dissertation

Teaching Strategy	Description of the Main Strategy Used
Lectures	These are interactive lectures weekly conducted according to course plan in a classroom and supported with variety of teaching formats including, lectures and multimedia presentations, use of whiteboard and solved examples, and class discussions, in which concepts, approaches, and case studies are presented, explored, and shown students what they need to know.
Coursework	Coursework is work performed by students for the purpose of learning. Coursework may be specified and assigned by teachers, or by learning guides in self-taught courses. Coursework can encompass a wide range of activities, including practice, experimentation, research, and writing. Usually assessed in order to count toward a final mark or grade.
Independent study	Independent study is an individualized learning experience that allows students to select a topic focus, define problems or questions, gather and analyze information, apply skills, and create a product to show what has been learned.
Self-learning	Students are encouraged to undertake independent study to both supplement and consolidate what are being learned.
Active learning	1. Active learning is any approach to instruction in which all students are asked to engage in the learning process. Active learning stands in contrast to "traditional" modes of instruction in which students are passive recipients of knowledge from an expert.
	2. In active learning teachers are facilitators rather than one-way providers of information. Other examples of active learning techniques include role-playing, case studies, group projects, think-pair-share, peer teaching, debates, Just-in-

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Teaching Strategy	Description of the Main Strategy Used
	Time Teaching, and short demonstrations followed by class discussion.
Computer hands-on sessions	Practical applications using a variety of software before the real design and implementation. A variety of web-based searches students will be assigned to learn how they can search for solutions using the Web.
Simulation exercises	Simulation exercises are normally run as field exercises and include a scenario that is as close to reality as possible.
Analysis and problem solving	The study of Engineering involves applying knowledge and problem-based learning. This allows students to become more active in their learning. As they pursue in their learning, they need to find out how to solve a particular problem. They can work out a problem collaboratively, practice research as well as testing different components to come up with a valid solution.
Laboratory work	During laboratory sessions, students will be given experiments to work in groups where they can apply the theories and principles gained. This gives them the opportunity to have hands-on experience to design and conduct experiments in addition to analyzing, interpreting data obtained from experiments, and maximize their learning through actual simulation
Presentations/ Presenting researches	Students present their work to the whole group, for discussion, criticism, and suggestions for improvement. Presentation sessions provide an opportunity to address questions, queries, and problems.
Project supervision	The teacher needs to set advance work for students, and then have the students present their work to the whole group, for discussion, criticism, and suggestions for improvement. Project sessions provide an opportunity to address questions, and problems.
Brain storming	Brainstorming is an effective technique for generating lists of ideas and creating interest and enthusiasm for new concepts or topics. Brainstorming provides teachers and students with an overview of what students know and/or think about a specific topic. Students can use brainstorming to organize their knowledge and ideas.

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Teaching Strategy	Description of the Main Strategy Used
Seminar	The teacher needs to set advance work for a selected number of students, and then have the selected students present their work to the whole group, for discussion, criticism, and suggestions for improvement. Seminar sessions provide an opportunity to address questions, queries, and problems.
Research activities	Research-led activities envisage activities in which students learn about current research in the discipline and are frequently an audience. The emphasis is put on the research content.

Assessment Strategy	Description of the main strategy used.
Written Exam	Midterm test is conducted in the 8 th week and final exam is conducted at the end of each course. Both tests are closed or open book, notes and resources. At least two quizzes must be done through the course.
Oral Discussion	To know the knowledge of the students.
Presentations	For final results displaying, to enhance the level of students in different subjects.
Quizzes	The entire assessment of Quizzes activities during the teaching period of each course.
Laboratory Reports	To demonstrate the personal skills, practical expertise, communication skills, report writing skills, and team work expertise they are expected to be learned and gained through their education.
Experimental and field work	For evaluation, to demonstrate the personal skills, practical expertise, communication skills, report writing skills, and team work expertise they are expected to be learned and gained through their education.
Survey	A review of all the research and work done in a specific area.
Assignments	The entire assessment of coursework activities during the teaching period of each course (which includes group and individual work, tests and presentations, etc.)

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Assessment Strategy	Description of the main strategy used.
Publish research	Academic publishing is the subfield of publishing which distributes academic research and scholarship. Most academic work is published in academic journal articles, books or theses. Peer review quality and selectivity standards vary greatly from journal to journal, publisher to publisher, and field to field.
Written report	Written report is a written document describing the findings of some individual or group; "this accords with the recent study by Hill and Dale" report, study. document, papers, written document - writing that provides information (especially information of an official nature)
Written research proposal	A research proposal should include: <ol style="list-style-type: none"> 1. Title. This is just a tentative title for your intended research. ... 2. Abstract. The proposal should include a concise statement of your intended research of no more than 100 words. ... 3. Research Context. ... 4. Research Questions. ... 5. Research Methods. ... 6. Significance of Research. ... 7. Bibliography.
Dissertation	A dissertation is usually done by a doctorate student and focuses on original research. By the time you are doing a dissertation you will have had a lot of practice writing essays. However, this is a large piece of work. A tip to help you keep all the writing focused on the theme. In 2 sentences summaries the theme of the dissertation. When you are writing, keep referring back to these 2 sentences. Check that what you are saying, the information you are using is relevant to theme in the sentences. This helps with longer essays too.
Thesis	A thesis, commonly required to obtain a master's degree, is supposed to test a student's understanding of his or her field of study.

12. Intended Learning Outcomes Mapping

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Dr. Adel Ahmed Al-Shokairi	Assoc. Prof. Dr. Mohammad Al_Gorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad
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See Annex (10)

13. Program Structure

Program Requirement	No. of Courses	Credit Hours	%
Complementary Courses	4	0 (Not credited)	0%
Faculty Requirement	1	3	8.33%
Compulsory Courses	7	21	58.33%
Elective Courses	2	6	16.66%
Thesis	-	6	16.66%
Total	10	36	100%

Complementary Courses (Not Credited)						
No	Course Code	Course Title	L	T	P	Cr. Hrs.
1	CNE322	Waves Propagation and Antennas	3			0
2	CNE323	Digital Communications	3			0
3	CNE347	Communications Networks 2	3			0
4	CNE427	Mobile Communications	3			0
Total						00

Compulsory Courses (8 Courses, 24 CH)						
No	Course Code	Course Title	L	T	P	Cr. Hrs.
1	CNE501	Stochastic Processes	3			3
2	CNE511	Advanced Digital Communications	3			3
3	CNE512	Communication Networks	3			3
4	CNE521	Advanced Digital Signal Processing	3			3

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Program Specification

Compulsory Courses (8 Courses, 24 CH)						
No	Course Code	Course Title	L	T	P	Cr. Hrs.
5	FR501	Research Methods and Project Preparation	3			3
6	CNE513	Advanced Wireless and Mobile Communications	3			3
7	CNE531	Optical Fiber Communications	3			3
8	CNE541	Network Security	3			3
Total						24

Elective Courses. Choose two courses (6 CH)						
No	Course Code	Course Title	L	T	P	Cr. Hrs.
1	PMxxx	Advanced Project Management	3			3
2	CNE581	Internet of Things	3			3
3	CNE582	Applied Machine Learning	3			3
4	CNE551	Broadband Access Networks	3			3
5	CNE552	Software Defined Networking	3			3
6	CNE571	Electromagnetic Interference & Compatibility	3			3
Total						18

Thesis

The student must prepare and discuss a thesis by (6) credit hours.

THESIS599 Master of Science Thesis

Thesis and Its Requirements (if any)

1. Registration of the thesis:

(Requirements/conditions and procedures for registration of the thesis as well as controls, responsibilities and procedures of scientific guidance)

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Program Specification

Thesis

- Completion of all required Compulsory & Elective Courses with average grade more than or equal to 75% .
- Completion of all university requirements.
- Field of Research and precise research topic with short Description and suggested time plan.
- First Department Seminar.
- Decision letter (Supervisors) of acceptance of the research topic.
- Thesis work should be done in at least 2-semesters.
- Thesis work should be done in at most 4-semesters.
- Any further requirements and controls based on post-graduate deanship regulations.

2. Scientific Supervision:

(The regulations of the selection of the scientific supervisor and his/her responsibilities, as well as the procedures/ mechanisms of the scientific supervision and follow-up)

- At most 2-supervisors are selected for the supervision of a thesis.
- At least 1-Associate (or Full) Professor is appointed as supervisor either from the department or from another department outside the faculty.
- Any Assistant Professor appointed as supervisor should have at least 4-year experience in the field of research and have published at least one paper.
- Candidates may apply for one-year extension (full-time) for completion of the thesis to the Postgraduate Program Administration at the Faculty of Engineering, which will be granted if the candidate provides a valid reason for extension.

The supervisor responsibilities are:

- Help and assist the candidate/researcher in preparing the research plan.
- Guide the candidate to adhere to certain standards of academic integrity and research ethics, including combating plagiarism.
- Monthly, follow up and meeting with the researcher (at least one meeting per month) ,
- Guide the researcher at every step to be done during thesis work,
- Write follow-up (progress report) after each meeting
- Write a follow-up (evaluation report) every semester.
- The supervisor shall submit copies of these reports to the Postgraduate-Program coordinator, the Head of the Department and the Head of the Faculty Post-graduate.
- Write the final thesis acceptance report in order to prepare the final department seminar and then initiating the preparation for thesis presentation, defense and approve.

The candidate/student responsibilities are:

- Student present his/her accomplishment at the end of every semesters

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Program Specification

Thesis

- plan and actively pursue the research;
- identify and deal with any research-related problems;
- comply with administrative requirement;
- meet ethical guidelines;
- take responsibility for the final form of the thesis
- A thesis or research portfolio is the outcome of independent research, or creative activity conducted under supervision.
- The length of a 6 credit hours thesis or research portfolio will be appropriate to the discipline and must not exceed 30,000 words, including bibliography, footnotes or endnotes and essential appendices, unless specific permission has been granted by the Department.

3.Thesis Defense/Examination:

(The regulations for selection of the defense/examination committee and the requirements to proceed for thesis defense, the procedures for defense and approval of the thesis, and criteria for evaluation of the thesis)

- A thesis proceeds for defense following completion of:
- At least one research paper is accepted in a journal in the field of research.
- Final acceptance letters provided by the supervisor(s) and the department final seminar committee (at least 3-department members),
- The examination committee should consist of - :
- One -Associate (or Full) Professor specialized in the field of research from an external university ,
- One -Associate (or Full) Professor from the department of electrical engineering in addition to the supervisor of the thesis.
- A session for presentation, defense and approval of the thesis should be done based on the following:
- At least two members of the examination committee accept their assignment and reply by acceptance letter and approve the thesis for defense within one month.
- The session of defense should be declared within two weeks after receiving of examination committee members' approval letters.

14. System of Study

Type of program	Coursework and Thesis
Study methods in the program:	Regular
The period to complete the program	Min. 2 Years (4 Terms)

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Program Specification

	Max. 3 + 1 Years (6 + 2 Terms)
Total Credit Hours for courses & Research	36

15. Study Plan

FR stands for Faculty Requirements.
 CNE5XX stands for Communications and Networks Engineering.

First Semester								
No.	Course Code	Course Name	اسم المقرر	Credit Hours				Prerequisites
				Lec.	Pr.	Tut.	Total C.H.	
1	CNE501	Stochastic Processes	العمليات العشوائية	3			3	
2	CNE531	Optical Fiber Communications	اتصالات الألياف الضوئية	3			3	
3	CNE512	Communication Networks	شبكات الاتصالات	3			3	
4	CNE521	Advanced Digital Signal Processing	معالجة الإشارات الرقمية المتقدمة	3			3	
5	CNE5xx	Elective I	اختياري I	3			3	
Total Credit Hours							15	

Second Semester								
No.	Course Code	Course Name	اسم المقرر	Credit Hours				Prerequisites
				Lec.	Pr.	Tut.	Total C.H.	
1	FR501	Research Methods and Project Preparation	طرق البحث وتحضير المشروع	3			3	
2	CNE513	Advanced Wireless and Mobile Communications	الاتصالات اللاسلكية والمتنقلة المتقدمة	3			3	Stochastic Processes
3	CNE511	Advanced Digital	الاتصالات الرقمية	3			3	Stochastic

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Second Semester							
No.	Course	Course Name	اسم المقرر	Credit Hours			Prerequisites
		Communications	المتقدمة				Processes
4	CNE541	Network Security	أمن الشبكة	3		3	Communication Networks
5	CNE5xx	Elective II	إختياري II	3		3	
Total Credit Hours							

Elective Courses. Choose two Courses (6 CH)								
No.	Course Code	Course Name	اسم المقرر	Credit Hours				Prerequisites
				Lec.	Pr.	Tut.	Total C.H.	
1	PMxxx	Advanced Engineering Project Management		3			3	
2	CNE581	Internet of Things		3			3	
3	CNE582	Applied Machine Learning		3			3	
4	CNE551	Broadband Access Networks		3			3	
5	CNE552	Software Defined Networking		3			3	
6	CNE571	Electromagnetic Interference & Compatibility		3			3	
Total Credit Hours								

Third Semester		
Course Code	Course Name	Cr. Hrs.
THESIS599	Thesis (Research and Writing)	6

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Fourth Semester		
Course Code	Course Name	Cr. Hrs.
THESIS599	Thesis (Research and Writing)	6

16. Admission Requirements:

1. Bachelor of Electrical Engineering Certificate with not less than 65 % passing ratio, or equivalent.
2. Interview
3. TOEFL / IBT: 60, or Equivalent
4. ICDL (Computer Skills)
5. Arabic Language
6. Student number capacity of 20 students per year
7. Transfer Requirements, and Courses Equivalency
8. Annex -13: shows the Admission Requirements for the Program

17. Graduation Requirements:

- Student attendance should not be less than 75%.
- Student will graduate after successfully passing the 30 credit hours courses and 6 credit hours Research.
- Student must achieve a minimum average score for all courses is 75% degree
- Minimum score for any student to pass any credit hours course is 65% degree.
- Grading System:
- | | |
|---------------------------------|-----------|
| From 90% to 100% of total marks | Excellent |
| From 80% to less than 90% | Very Good |
| From 75% to less than 80% | Good |
| From 65% to less than 75% | Pass |
| Less than 65% | Poor/Fail |

18. Learning Resources, Facilities, and Equipment for Running the Program

Learning Resources:

- Policies and Procedure for providing and quality assurance of learning resources textbooks, references and other resource materials, including electronic and web-based resources, Journal Database, etc.
- University database which allows access to most of the international publishing houses

Facilities and Equipment:

Policies and Procedure for providing and quality assurance of Facilities and Equipment (Library, laboratories, medical facilities, classrooms, etc.).

List of laboratories:

- Communications Engineering Laboratory
- Computer Laboratory

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Rector of Sana'a University			
Prof. Dr. Al-Qassim Mohammed Abbas			

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19. Teaching staff				
	Professor	Associate Professor	Assistant Professor	Technicians Assistants
Required Number				
Available Number	-	3	6	-
Note:				

20. Program Management and Regulations
<p>1. Program Management</p> <p>1.1 Program Structure (Including boards, councils, units, committees, etc.)</p> <p>Electrical Engineering Department Board Postgraduate Studies Administration Vice Dean for Postgraduate Studies College of Engineering Board Vice Presidency of the University for Postgraduate Studies</p> <p>1.2 Stakeholders' Involvement Describe the representation and involvement of stakeholders in the program planning and development. (Students, professional bodies, scientific societies, alumni, employers, etc.)</p> <p>The stakeholders were involved in designing the program, including universities, research centers, the public and private sectors, through their participation in a workshop as well as in responding to and submitting a questionnaire.</p> <p>2. Program Regulations Provide a list of related program regulations, including their link to online version: admission, study and exams, recruitment, appeals and complaint regulations, etc.)</p> <p>Decision of the Presidency of the Council of Ministers No. 40 of 2008 Decision of the Presidency of the Council of Ministers No. 141 of 2008 Graduate Studies Guide to Sana'a University</p>

21. Evaluation of Program Quality Matrix			
Evaluation Areas/Aspects	Evaluation Sources/References	Evaluation Methods	Evaluation Time

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21. Evaluation of Program Quality Matrix

Note:

Evaluation Areas/Aspects (e.g., leadership, effectiveness of teaching & assessment, learning resources, partnerships, etc.)

Evaluation Sources (students, graduates, alumni, faculty, program leaders, administrative staff, employers, independent reviewers, and others (specify))

Evaluation Methods (e.g., Surveys, interviews, visits, etc.)

Evaluation Time (e.g., beginning of semesters, end of academic year, etc.)

22. List of Annexes

Annex (1)	Academic Standards Curriculum Criteria of Accreditation Board for Communications and Networks Engineering Program.
Annex (2)	Survey of names of Similar Accredited Programs at International Universities (Benchmarks) for Communications and Networks Engineering Programs.
Annex (3)	Survey of Intended Learning Outcomes for similar Accredited Communications and Networks Engineering Programs at International Universities.
Annex (4)	Summary of similar Programs (Benchmarks) for Master of Science in Communications and Networks Engineering Program.
Annex (5)	Survey of course names of Similar Programs.
Annex (6)	Survey/Mapping of Vision, Mission and Objectives of similar Accredited Programs at International Universities (Benchmarks) for Masters of Science in Communications and Networks Engineering Programs.
Annex (7)	Mapping of the Mission and Objectives of the Program with the Vision, Mission and Objectives of Faculty, and the University.
Annex (8)	Main Themes/Sub-Themes with Relative weight for Program (if need)
Annex (9)	PILOs Distribution to General Themes for Program (if need)
Annex (10)	Matrix of Mapping Program P- ILO's with Courses
Annex (11)	Mapping the Benchmarks with PILO's (if need)
Annex (12)	Mapping Program's Goals with Intended Learning Outcomes
Annex (13)	The Admission Requirements for the Program.

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23. Attachment of Courses specification and Syllabi of the Program

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Rector of Sana'a University			
Prof. Dr. Al-Qassim Mohammed Abbas			

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Appendix

Head of the Department Dr. Adel Ahmed Al-Shokairi	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Al_Gorafi	Dean of the Faculty Prof. Dr. Mohammed AL- Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al- Emad
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Program Specification

Prepared by:

Relationship between Program Mission and the Mission of the Faculty.

Relationship between Program Goals and the Goals of the Faculty

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Rector of Sana'a University			
Prof. Dr. Al-Qassim Mohammed Abbas			

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Program Specification

ملحق (1) المعايير الأكاديمية للمحتوى لهيئة الاعتماد المقترحة لبرنامج ماجستير في هندسة الاتصالات والشبكات

Annex (1): Academic Standards Curriculum Criteria of Accreditation Board for Master of Science in Communications and Networks Engineering Program

External Reference Points

- UK Higher Education Programs Accreditation, the Institution of Engineering and Technology (IET).
- The Quality Assurance Agency (QAA) Subject Benchmark Statement: Engineering, Feb 2015.
- The QAA Framework for Higher Education Qualifications, October 2019.
- The ASIIN, a well-respected German quality assurance institution.
- The Engineering Accreditation Commission of ABET.
- The Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), USA.

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ملحق (2) مسح أسماء البرامج المعتمدة المماثلة لبرنامج ماجستير في هندسة الاتصالات والشبكات

Annex (2): Survey of International Accredited Programs Similar to Master of Science in Communications and Networks Engineering Program

#	The Academic Program اسم البرنامج المماثل	The University الجامعة	The Faculty الكلية	The Department القسم	The Country الدولة	Program Accrediting Body جهة اعتماد البرنامج	Degree Award at Program Completion التي يمنحها الدرجة البرنامج للخريج	Year of accreditation سنة الحصول على الاعتماد	Type of program
The 1 st Program البرنامج الاول	MSc Communication Systems and Networks	TH Köln – University of Applied Sciences	Faculty of Information, Media and Electrical Engineering	Institute for Communications Engineering	Germany	accredited by ASIIN, a well-respected German quality assurance institution.	Master of Science	until Sep 30, 2025	Coursework and Thesis
The 2 nd Program البرنامج الثاني	MSc Mobile Communications and Smart Networking	University of Southampton	Faculty of Engineering and Physical Sciences	Electronics and Computer Science	UK	accredited by the Institution of Engineering and Technology (IET)	MSc Mobile Communications and Smart Networking	N/A	Coursework and Research Project
The 3 rd Program البرنامج الثالث	Master in Telecommunication Engineering	Universidad Politécnica de Madrid (UPM)	Information and Communication Technologies	School of Telecommunication Engineering	Spain	accredited by the Engineering Accreditation Commission of ABET	MSc Telecommunications Engineering	since 2009	Coursework and Thesis
The 4 th Program البرنامج الرابع	MSc. Telecommunications and Networks Engineering	University of Bahrain	College of Engineering		Kingdom of Bahrain	accredited by ABET	MSc	N/A	Coursework and Thesis

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#	The Academic Program اسم البرنامج المماثل	The University الجامعة	The Faculty الكلية	The Department القسم	The Country الدولة	Program Accrediting Body جهة اعتماد البرنامج	Degree Award at Program Completion التي يمنحها الدرجة البرنامج للخريج	Year of accreditation سنة الحصول على الاعتماد	Type of program
The 5 th Program البرنامج الخامس	MSc. Telecommunications Engineering	The University of Texas at Dallas	Erik Jonsson School of Engineering and Computer Science	Department of Electrical and Computer Engineering	USA	accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC)	MSc.	N/A	Coursework and Thesis
The 6 th Program البرنامج السادس	MSc. Telecommunication Engineering	King Fahd University of Petroleum and Minerals	College Of Engineering and Applied	Electrical Engineering Department	KSA	ABET	MSc.	N/A	Coursework and Thesis

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Program Specification

#	The Academic Program اسم البرنامج المماثل	The University الجامعة	The Faculty الكلية	The Department القسم	The Country الدولة	Program Accrediting Body جهة اعتماد البرنامج	Degree Award at Program Completion التي يمنحها الدرجة البرنامج للخريج	Year of accreditation سنة الحصول على الاعتماد	Type of program
		(KFUPM)	Engineering						

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Program Specification

ملحق (3) مسح مخرجات التعلم في البرامج المماثلة لبرنامج ماجستير في هندسة الاتصالات والشبكات

Annex (3): Survey of Intended Learning Outcomes for Programs Similar to Master of Science in Communications and Networks Engineering Program

Program Intended Outcomes	Suggested PILOs for the Current Program: Master of Science in Communications and Networks Engineering						
	1 st Program	2 nd Program	3 rd Program	4 th Program	5 th Program	6 th Program	
A. Knowledge and understanding	Upon successful completion of the Program, graduates should be able to:						
	A1.	Demonstrate advanced knowledge and understanding of mathematical methods, scientific and engineering principles, and engineering specialization relevant to communication systems and network engineering.	√	√	√	√	√
	A2.	Develop an understanding of the contemporary technical and professional issues in engineering.	√		√	√	

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Program Intended Outcomes	Suggested PILOs for the Current Program: Master of Science in Communications and Networks Engineering		1st Program	2nd Program	3rd Program	4th Program	5th Program	6th Program
	A3.	Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	√	√	√	√		√
	A4.	Acquire and apply new knowledge as needed, using appropriate learning skills and strategies.	√	√	√	√	√	√
B.	Upon successful completion of the Program, graduates should be able to:							
Cognitive/ Intellectual Skills	B1.	Model and simulate the behavior of wireless communication channels, transmitters, and receivers.		√	√	√	√	

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Program Intended Outcomes	Suggested PILOs for the Current Program: Master of Science in Communications and Networks Engineering		1 st Program	2 nd Program	3 rd Program	4 th Program	5 th Program	6 th Program
	B2.	Critically analyze and compare the performance and complexity of various technical options for mobile communication systems and networks.	√	√	√	√	√	√
	B3.	Identify, formulate, and solve complex engineering problems in communication systems and networks by using appropriate techniques, technologies and/or tools.	√	√	√	√		√
	B4.	Investigate and critically evaluate current research and literature review related to specialized areas of communications and networks, industrial documentation, standards, analyze and interpret data, and use engineering judgment to draw conclusions.		√	√	√	√	√

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Program Intended Outcomes	Suggested PILOs for the Current Program: Master of Science in Communications and Networks Engineering		1st Program	2nd Program	3rd Program	4th Program	5th Program	6th Program
C. Practical and Professional Skills	Upon successful completion of the Program, graduates should be able to:							
	C1.	Apply appropriate mathematical and computer-based methods for modeling and analyzing discipline-specific engineering problems.	√	√	√	√	√	
	C2.	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	√	√	√	√		√
	C3.	Apply alternative methods for solving engineering problems and identify advantages and disadvantages of the alternative methods.	√	√	√	√	√	
	C4.	Conduct research independently and collaboratively, and produce technical reports, a master thesis, and scientific technical papers.	√	√	√	√	√	√

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Program Specification

Program Intended Outcomes	Suggested PILOs for the Current Program: Master of Science in Communications and Networks Engineering		1 st Program	2 nd Program	3 rd Program	4 th Program	5 th Program	6 th Program
D. General and Transferable Skills	Upon successful completion of the Program, graduates should be able to:							
	D1.	Apply engineering techniques, skills, and modern engineering tools in problem solving, and make competent decisions in complex and unpredictable situations.	√	√	√	√	√	
	D2.	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	√	√	√	√	√	√
	D3.	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	√	√	√	√		√

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 Master of Science in Communications
 and Networks Engineering



Program Specification

Program Intended Outcomes	Suggested PILOs for the Current Program:						
	Master of Science in Communications and Networks Engineering						
		1st Program	2nd Program	3rd Program	4th Program	5th Program	6th Program
D4.	Communicate technical information orally, visually, in writing, and in drawings using professional media with clear and concise arguments.	√	√	√	√	√	√

Intended Learning Outcomes for Similar Programs

Program 1: MSc. Communication Systems and Networks

Upon successful completion of this Program, graduates should be able to:

1. Apply the principles and technical knowledge of engineering and use the current tools and techniques to develop and implement engineering solutions at an advanced level.

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Program Specification

2. Apply the principles, and technical knowledge and methods of telecommunication and network engineering and use the current tools and techniques to solve complex problems in telecommunication and computer network systems at an advanced level.
3. Proficiently use mathematical tools and techniques to achieve appropriate solutions to telecommunication and network engineering problems consistent with professional standards.
4. Critically investigate a problem, drawing on current telecommunication and network engineering knowledge and research for the purpose of formulating and evaluating an appropriate, effective solution.
5. Demonstrate a comprehensive awareness of social, cultural and environmental issues when solving engineering problems and abide by the professional and ethical requirements mandated by Engineers Australia.
6. Appraise and synthesize information to review, assess and suggest improvements to projects, plans and processes with appropriate creativity and innovation, all of which are consistent with professional standards.
7. Communicate technical information orally, in writing, and in drawings using professional media with clear and concise arguments, to technical and non-technical audiences consistent with professional standards.

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Program Specification

8. Manage personal professional development, relationships and work practices including proactively collaborating and contributing efficiently and effectively as both a team leader and a professional engineer.

Program 2: MSc. Mobile Communications and Smart Networking

Knowledge and Understanding

On successful completion of this program, graduates should be able to demonstrate knowledge and understanding of:

- A1. The scientific and engineering principles underpinning mobile communications and smart networking
- A2. Advanced concepts in specialist areas of mobile communications and networking, such as transceiver design, advanced modulation techniques and routing design
- A3. Techniques, technologies and tools used in these areas
- A4. Methods of design, analysis and evaluation used in these areas
- A5. Applicable methods of research and enquiry

Intellectual and Research Skills

On successful completion of this program, graduates should be able to:

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Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas			

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Program Specification

- B1. Specify, design and evaluate transmitter and receiver technologies with attention to a wide range of outcomes, including technical, practical, efficiency and security
- B2. Model and simulate the behavior of wireless communication channels and parts of wireless devices at the appropriate level of detail
- B3. Critically analyze and compare the performance of various technical options for mobile networks combined with intelligent processing for improved performance and reduced complexity
- B4. Find, read, understand and explain literature related to advanced and specialized areas of mobile communications and smart networking, including scientific publications, industrial documentation, standards, ethical, legal and environmental guidance
- B5. Plan and manage a research project involving an advanced and specialized aspect of mobile communications and smart networking, using appropriate state of the art techniques, technologies and/or tools

Practical Skills

On successful completion of this program, graduates should be able to:

- C1. Use specialist tools and techniques to specify, simulate and analyze mobile communications and networking systems

Transferable and Generic Skills

On successful completion of this program, you will be able to:

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Program Specification

- D1. Use conventional and electronic indexing and search methods to find technical information
- D2. Present technical information concisely in written and verbal forms to a range of audiences
- D3. Work in a pair or in a small group on a given task, managing your own contribution and the overall task
- D4. Work independently on a significant research project, managing time and risk in an effective manner
- D5. Recognize legal and ethical issues of concern to business, professional bodies and society, and follow relevant guidelines to address these issues

Program 3: MSc. Telecommunication Engineering

On successful completion of this program, graduates should be able to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. Communicate effectively with a range of audiences
4. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

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Program Specification

5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. Acquire and apply new knowledge as needed, using appropriate learning strategies

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Program Specification

Program 4: MSc. Telecommunications and Networks Engineering

Students enrolled in the program will attain the following outcomes by the time they graduate:

- a. An ability to apply knowledge of mathematics, science, and engineering
- b. An ability to design and conduct experiments, as well as to analyze and interpret data
- c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- d. An ability to function on multidisciplinary teams
- e. An ability to identify, formulate, and solve engineering problems
- f. An understanding of professional and ethical responsibility
- g. An ability to communicate effectively
- h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

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Program Specification

- i. A recognition of the need for, and an ability to engage in life-long learning
- j. A knowledge of contemporary issues
- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- l. An ability to conduct research

Program 5: MSc. Telecommunications Engineering

Knowledge and Understanding

By the end of this program, students should be able to:

- A1. Acquire advanced knowledge at a greater depth beyond that on a normal BEng (Hons) degree programs in a range of Electronic and Electrical Engineering subjects.
- A2. Analyze and discuss the importance of entrepreneurship and how it can be managed.
- A3. Construct and evaluate advanced models of various manufacturing techniques
- A4. Differentiate, analyze and discuss various product lifetime management solutions and how they affect different sectors of industry.

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Program Specification

Intellectual Skills

By the end of this program, students should be able to:

- B1. Apply their knowledge to the detailed solution of practical problems.
- B2. Analyze a problem and plan a conceptual solution.
- B3. Devise an effective program of work to implement that solution.
- B4. Evaluate the results of their work objectively and develop further strategies independently.
- B5. Synthesize information from a variety of sources and develop their own skills and knowledge.

Practical Skills

By the end of this program, students should be able to:

- C1. Use standard test and measurement equipment accurately, follow instruction and keep good records.
- C2. Choose and apply suitable prototyping and production methods and components.
- C3. Use industry-standard IT tools for simulations, fabrications, implementation and communication.
- C4. Evaluate safety implications and work appropriately.

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Program Specification

Transferable Skills

By the end of this program, students should be able to:

- D1. Communicate their ideas efficiently in writing.
- D2. Work effectively with their peers
- D3. Construct realistic time management plans for carrying out project work.

Program 6: MSc. Telecommunication Engineering

On successful completion of this program, students should be able to demonstrate the following learning outcomes:

- a) Master the knowledge of telecommunications engineering concepts.
- b) Conduct research independently and collaboratively.
- c) Formulate problems and plan a procedure for solution.
- d) Communicate, organize and present information effectively.
- e) Pursue advanced graduate studies and lifelong learning.

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f) Realize the relevance of economics, ethics and teamwork to the profession.

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Program Specification

ملحق (4) ملخص البرامج المماثلة لبرنامج ماجستير في هندسة الاتصالات والشبكات

Annex (4): Summary of Programs Similar to Master of Science in Communications and Networks Engineering Program

	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
The Program Title	MSc. Communication Systems and Networks	MSc Mobile Communications and Smart Networking	MSc. Telecommunication Engineering	MSc. Telecommunications and Networks Engineering	MSc. Telecommunications Engineering	MSc Telecommunication Engineering	MSc. Communications and Networks Engineering
The Faculty	Faculty of Information, Media and Electrical	Faculty of Engineering and Physical	Information and Communication Technologies	College of Engineering	Erik Jonsson School_of Engineering and	College Of Engineering and Applied	Faculty of Engineering

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Program Specification

	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
	Engineering	Sciences			Computer Science	Engineering	
The University	TH Koln – University of Applied Sciences	University of Southampton	Universidad Politécnic de Madrid (UPM)	University of Bahrain	The University of Texas at Dallas	King Fahd University of Petroleum and Minerals (KFUPM)	Sana'a University
The Country	Germany	UK	Spain	Kingdom of Bahrain	USA	KSA	Yemen

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Program Specification

	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
Type of program	Coursework and Thesis	Coursework and Research Project	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis
Study methods in the program:	Full-time	Full-time	Full-time	Full-time	Full-time	Full-time	Full-time
Number of semesters	3 semesters	3 semesters	Two years (4 semesters)	4 semesters	Two years (4 semesters)	4 semesters	4 semesters
Total Credit	63 ECTS	60 ECTS (120	90 ECTS	24 CH	33 CH	24 CH	24 CH

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Program Specification

	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
Hours (without Thesis)	points *	CATS)					
Credit Hours for compulsory courses	48 ECTS points	37.5 ECTS (75 CATS	60 ECTS	24 CH	15 CH	15 CH	18 CH
No. of Courses for Electives	3	3 modules	6	—	4	3	2

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Program Specification

	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
courses							
No. of Courses for compulsory courses	9	5 modules	12	6	5	5	6
Credit Hours for Electives courses	15 ECTS	22.5 ECTS (45 CATS)	30 ECTS	—	12 CH	9 CH	6

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Program Specification

	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
Complementary courses to join the program and their number	—	—	—	—	—	—	—
Credit Hours for Thesis	27 ECTS	30 ECTS (60 CATS)	30 ECTS	12 CH	6 CH	6 CH	6 CH
Total Credit Hours for courses &	90 ECTS credit points	90 ECTS (180 CATS)	120 ECTS	36 CH	33 CH	30 CH	30 CH

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Program Specification

	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
Thesis							
The period for thesis completion	1 semester	1 semester	1 year	1 year	1 semester	1 year	1 year
Min. period to complete the program	3 semesters	3 semesters	2 years	2 years	2 years	2 years	2 years
Max. period to complete the	—	—	—	—	—	2.5 years	3 + 1 years

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	The Similar Programs (Benchmarks)						Current program
	The 1st Program	The 2nd Program	The 3rd Program	The 4th Program	The 5th Program	The 6th Program	
program							

* European Credit Transfer System (ECTS). Note that 2 ECTS = 1 US credit hour.

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Program Specification

ملحق (5) مسح أسماء المقررات الدراسية في البرامج المماثلة لبرنامج ماجستير في هندسة الاتصالات والشبكات
 Annex (5): Survey of Course Names of Similar Programs

Program	The 1 st Program	The 2 nd Program	The 3 rd Program	The 4 th Program	The 5 th Program	The 6 th Program	Current Program
University	TH Koln – University of Applied Sciences	University of Southampton	Universidad Politécnica de Madrid (UPM)	University of Bahrain	The University of Texas at Dallas	King Fahd University of Petroleum and Minerals (KFUPM)	Sana'a University
Faculty	Faculty of Information, Media and Electrical Engineering	Faculty of Engineering and Physical Sciences	Information and Communication Technologies	College of Engineering	Erik Jonsson School of Engineering and Computer Science	College Of Engineering and Applied Engineering	Faculty of Engineering

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Program Specification

Country	Germany	UK	Spain	Kingdom of Bahrain	USA	KSA	Yemen
No. of Courses	12	8 modules	18	6	9	8	8
Total Cr. Hrs.	90 ECTS credits	90 ECTS (180 CATS)	120 ECTS	36 CH	33 CH	30 CH	30 CH
Total Years	1.5 years	1.5 years	2 years	2 years	2 years	2 years	2 years
Term No.	No.	Course Name	Course Name	Course Name	Course Name	Course Name	Course Name
1	1	Advanced Mathematics	Simulation of Mobile Communications		Statistical Data Analysis and Research Methods	Probability, Random Variables, and Statistics	Stochastic Processes

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Program Specification

	2					Optical Communication Systems Optical Network		Optical Fiber Communications
	3	Next Generation Networks		Communication Networks	Advanced Communication Networks Modern Telecommunications Systems	Introduction to Telecommunications Networks Telecommunication Network Algorithmic Aspects of Telecommunication Networks Performance of Computer Systems and Networks Advanced Computer	Computer Networks Local and Metropolitan Networks	Communication Networks

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Program Specification

						Networks		
	4	Digital Signal Processing	Signal Processing Advanced Systems and Signal Processing	Signal Analysis for Communications		Digital Signal Processing I Digital Signal Processing II Introduction to Speech Processing Adaptive Signal Processing		Advanced Digital Signal Processing
	5				Internet of Things			Internet of Things
	6							

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Program Specification

	1	Research Project, Part A Research Project, Part B	Research Methods and Project Preparation					Research Methods and Project Preparation
	2		Advanced Wireless Communication s Networks and Systems Wireless and Mobile Networks Wireless Transceiver Design and Implementation	Radio Access Technologies		Introduction to Wireless Communication Systems Signaling and Coding for Wireless Communication Systems Propagation and Devices for Wireless Communications	Wireless and Personal Communications	Advanced Wireless and Mobile Communications

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Program Specification

	3			Digital Coding and Transmission		Digital Communication Systems	Digital Communications I Digital Communications II	Advanced Digital Communications
	4					Network Security	Computer and Network Security Data Security and Encryption	Network Security
	5	Project Management		Project Management		Management	Management of Information Information Resource Management	Advanced Engineering Project Management
				Communication Systems				

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Program Specification

				Multimedia Systems and Services				
				User Equipment and Terminals				
				instrumentation systems Engineering				
				Applications and Services				
				Strategic Vision of Technologies and Systems Integration in ICT Sector				
				Integration of				

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Program Specification

				Networks, Applications and Contents			
					Principles of Artificial Intelligence		
3	1	Master's Thesis	MSc Project		Thesis		Thesis
	2						
	3						
	4					Thesis	
4	1				Thesis		Thesis, continue
Total CH		90 ECTS	90 ECTS (180 CATS)	120 ECTS	36 CH	33 CH	30 CH

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ملحق (6) الرؤية والرسالة والاهداف للبرامج المعتمدة المماثلة لبرنامج ماجستير في هندسة الاتصالات والشبكات

Annex (6): Vision, Mission and Objectives of International Accredited Programs Similar to Master of Science in Communications and Networks Engineering Program

	The 1 st Program	The 2 nd Program	The 3 rd Program	The 4 th Program	The 5 th Program	The 6 th Program
Country	Germany	UK	Spain	Kingdom of Bahrain	USA	KSA
University	TH Koln – University of Applied Sciences	University of Southampton	Universidad Politécnica de Madrid (UPM)	University of Bahrain	The University of Texas at Dallas	King Fahd University of Petroleum and Minerals (KFUPM)

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Faculty	Faculty of Information, Media and Electrical Engineering	Faculty of Engineering and Physical Sciences	Information and Communication Technologies	College of Engineering	Erik Jonsson School_of Engineering and Computer Science	College Of Engineering and Applied Engineering
Department / Program	Institute for Communications Engineering	Electronics and Computer Science	School of Telecommunication Engineering		Department of Electrical and Computer Engineering	Electrical Engineering Department
Study Duration	3 semesters	3 semesters	2 years (4 semesters)	2 years	2 years	2 years

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Program Accrediting Body	accredited by ASIIN, a well-respected German quality assurance institution.	accredited by the Institution of Engineering and Technology (IET)	accredited by the Engineering Accreditation Commission of ABET	accredited by ABET	accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC)	ABET
Department Vision				To become a center excellence in both graduate studies and scientific research in the Kingdom of Bahrain and the Gulf region, and contribute to the academic advancement and scientific publishing worldwide.		To be globally known for skillful graduates and quality research with focus on national needs.

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Department Mission				- The Deanship of Graduate Studies and Scientific Research is mandated to promote a culture of scientific research and to encourage academic experience of post-graduate students. The deanship works on leveraging the quality of research and development through	The mission of the Electrical Engineering Program is to provide excellent education in modern electrical engineering practice. Our graduates are highly qualified for rewarding and successful careers in a diverse range of modern electrical engineering fields.	<ul style="list-style-type: none"> • Imparting profound knowledge in the areas of electrical engineering. • Enriching graduates with technical and soft skills to take up leading role in the society. • Producing high quality research with focus on energy-related challenges.

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				strengthening the university's relationship with the society, and benefit from industry-driven research opportunities in resolving problems and issues of the society.		
Department Objectives				<ul style="list-style-type: none"> To achieve the mission of the university associated with scientific research and implement the policy so 		

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				<p>determined, in accordance with national strategies related to scientific research.</p> <ul style="list-style-type: none"> • Follow up on the admission procedures for graduate students in coordination with the Deanship of Admission and Registration. • Co-ordination plans and programs of the different graduate studies with the respective colleges. 		

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Program Mission					The mission of the Telecommunications Engineering degrees program is to provide excellent education in modern communications networks and systems. Our graduates are highly qualified for rewarding and successful careers in a diverse range of telecommunications	

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					engineering fields.	
Program Objectives		The aims of the program are to enable you to: 1) Develop original ideas and solve complex problems in new or unfamiliar environments, based on advanced	Graduates in the Master in Telecommunication Engineering will have: • The ability to apply technical and scientific knowledge for	The graduate from the MSc in Electrical Engineering Program at the University of Bahrain will: 1. Be successful in technical careers related to electrical and electronics	The Graduate Program in Telecommunications Engineering (TE) provides intensive preparation for professional practice in the design, programming, theory, and applications of telecommunications	The program leading to the degree of Master of Science in Telecommunication Engineering provides an opportunity for the students to pursue advanced studies in this area, and to engage in research.

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		<p>knowledge of the principles and methodologies of mobile communications and networking</p> <p>2) Integrate knowledge and handle complexity in this area of electronic engineering, formulating sound judgments with incomplete or</p>	<p>research, development, innovation and management in multidisciplinary environments, to generate and transfer new technological knowledge, and to lead complex projects in services, systems, equipment's and</p>	<p>engineering.</p> <p>2. Pursue post-graduate education in electrical and electronics engineering.</p> <p>3. Become leaders in fields related to electrical and electronics engineering.</p>	<p>networks. It is designed to serve the needs of engineers who wish to continue their education. The Telecommunications Engineering Program offers courses of study leading to the MS and a PhD degree in Telecommunications Engineering. Education and training are provided to both academically oriented</p>	<p>The specific objectives of the M.S.T.E. program is to:</p> <p>Develop an introductory level of competence in conducting research.</p> <p>Acquaint knowledge on the state-of-the art technologies in telecommunications.</p> <p>Demonstrate the</p>

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		limited data 3) Communicate your conclusions and the underpinning knowledge and rationale clearly and unambiguously to specialist and non-specialist audiences 4) Develop your independent learning skills as	components in Information and Communication Technologies and related fields. • The ability to successfully practice the Telecommunication Engineer profession, including normative, regulative and		students and students with professional goals in industrial or governmental occupations requiring advanced knowledge of telecommunications and related technology. A comprehensive program of evening courses is also offered, which enables part-time students to earn the MS and PhD degree	ability to learn independently and generate new knowledge in their chosen field of study. Become an effective professional engineer in the area of expertise. Develop leadership, skills and ethics of the

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		required for continued professional development	ethical issues, being aware of the economic and social context.		or to select individual courses of interest. Courses and research are both offered in a variety of subfields of telecommunications engineering, including, fault-tolerant networks, digital communications, modulation and coding, electromagnetic-wave propagation, fiber and integrated optics,	profession. The program objectives are strongly aligned to the university mission that indicates commitment to "graduating leaders who are knowledgeable, skillful, and productive members of the society" as well as "creating new knowledge". The

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					lasers, wireless communications, mobile computing, wireless multimedia, DWDM networks, QoS assurance protocols, network design and optimization, telecommunications software, performance of systems, ad-hoc and PCS wireless networks, network security and high speed transmission	objectives emphasize competency, self-learning, profession skills, leadership and generating new knowledge

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					protocols.	
Website Link	https://www.th-koeln.de/en/homepage_26.php https://www.th-koeln.de/en/information-media-and-electrical-engineering/faculty-of-information-	https://www.southampton.ac.uk/courses/postgraduate-taught https://www.southampton.ac.uk/courses/mobile-communications-and-smart-networking-	http://www.etsit.upm.es/de/studies/master-of-science-in-telecommunication-engineering.html	http://www.uob.edu.bh/en/index.php/administration/deanships/deanship-of-graduate-studies-and-scientific-research	https://ece.utdallas.edu/academics/graduate-programs/telecommunications-engineering/ https://catalog.utdallas.edu/2020/graduate/programs/ecs/telecom-engineering#master-of-science-in-telecommunications-	http://www.kfupm.edu.sa/departments/ee/Pages/en/MS-TE.aspx kfupm.edu.sa

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	media-and-electrical-engineering_6817.php	masters-msc			engineering	

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ملحق (7) مؤامة رؤية ورسالة وأهداف البرنامج مع رؤية ورسالة واهداف القسم والكلية والجامعة

Annex (7): Mapping of Vision, Mission, and Objectives of the Program with Vision, Mission, and Objectives of Department, Faculty, and University

Mapping of Program Vision with Department, Faculty, and University Vision

University Vision	Faculty Vision	Department vision	Program vision
Sana'a University aspires to achieve a national leading role in teaching, learning, scientific research and community service; and to be among the best regional universities and the foremost house of expertise and think tank in Yemen.	To excel in engineering education & scientific research with distinction at the local and regional levels.		To be locally and regionally recognized program for academic advancement and pioneering research in the area of next-generation communications and networking technologies solutions.

Mapping of Program Mission with Department, Faculty, and University Mission

University Mission	Faculty Mission	Department Mission	Program Mission
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<p>To contribute to the sustainable development efforts by providing an accredited higher education environment and excellent research services within a fruitful national partnership based on transparency, professionalism and creativity.</p>	<p>To provide excellent and accredited engineering education to meet the development needs and match the labor market requirements locally and regionally.</p>	<p>Graduate qualified Engineers in Electric Power, Communication and Computer Engineering in accordance with programs committed to the international quality standards. The Graduating Engineers handed with enough knowledge and skills necessary to meet the requirements of development as well as local and regional labor markets. Also, they able to self-development and proceed with contemporary issues. The department contribute to community wellness and the country development through scientific research, advisory services, and training and education programs.</p>	<ul style="list-style-type: none"> • To advance knowledge and educate engineers who will make the world a better place by using the power of engineering principles, techniques and systems. • To focus on equipping engineers with the state-of-art knowledge and skills they need for work and for life. • To empower practicing engineers with the state-of-art technology to meet the growing challenges of the industry. • To carry out research through constant interaction with research organizations and industry.
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Mapping of Program Objectives with Department, Faculty, and University Objectives

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Mapping of Program Objectives with Department, Faculty, and University Objectives

University Objectives	Faculty Objectives	Department Objectives	Program Objectives
1. To provide specialized and in-depth academic opportunities for students in different fields of knowledge to meet the country's needs of specialties, technicians and experts, with special focus on the following:	7. To offer study programs in various fields of knowledge and equip students with required knowledge and scientific and know-how skills to utilize them in resolving problems effectively and efficiently.	7. Graduate high qualified engineers in Electrical Power, Communication and Computer Engineering able to compete at national and regional levels.	The program objectives are to: 1. Develop advanced knowledge and broad understanding of the principles and methodologies of communications and networks engineering.
2. To boost the level and quality of preparation and qualification tasks.	8. To develop positive trends towards engineering science and its accelerating developments and enable students to use the techniques and methods of conducting scientific research in	8. Update undergraduate and post graduate programs and enhance the applied research environment to contribute in country development.	2. Apply their knowledge to design, investigate and solve complex problems in the areas of communication systems and networking.

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Mapping of Program Objectives with Department, Faculty, and University Objectives

	engineering fields.		
3. To create a general culture aiming at developing the elements of sound Islamic personality and the proper cognitive and scientific training.	9. To develop skills of scientific, innovative and critical thinking as well as the concept of continuous self-education.	9. Establish partnerships with the public and private sectors and provide engineering consultancies, continuous training, teaching and awareness programs.	3. Promote scientific and applied research particularly that is related to development local Telecommunications companies.
4. To stabilize the true Islamic vision emanating from the broad horizons of Islamic knowledge and its perception of the universe, man and life.	10. To strengthen scientific ties with national and international colleges, scientific bodies, and research & development centers.	10. Improve the academic staff to student ratio as per standard.	4. Develop their independent learning skills as required for continued professional development.
5. To develop innovative and critical scientific thinking skills.	11. To provide technical and specialized studies and	11. Fill the gap in the number of assistance staff and laboratory	5. Develop high-level oral and written communication skills specific to the needs of the

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Mapping of Program Objectives with Department, Faculty, and University Objectives

	consultations to various state bodies and institutions, both public and semi-public, and utilize them in resolving the environment and society issues to promote sustainable development.	technicians and implement training programs to enhance their skills.	communication systems industry and network engineering.
6. To provide students with the required knowledge and scientific and applied skills for solving problems effectively and efficiently	12. To develop a spirit of co-operation, group work, effective leadership, sense of responsibility, and ethical commitment	12. Commit and uphold high ethical and professional conduct in the education and practice of engineering.	

ملحق (8) المساقات الرئيسية واوزانها الفرعية لبرنامج ماجستير في هندسة الاتصالات والشبكات

Annex (8): Main Themes/Sub-Themes with Relative weight for Master of Science in Communications and Networks Engineering Program

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No.	Themes	Credit Hours	Courses Number	Relative weight for Theme	Sub-Themes
1	N/A				-
2					-
3					-
4					-
5					-
Total				100%	

* This total is the overall total of both Compulsory and Elective courses.

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ملحق (9) توزيع مخرجات التعلم لبرنامج ماجستير في هندسة الاتصالات والشبكات مع المساقات الرئيسية
 Annex (9): PILOs Distribution to Main Themes for Master of Science in Communications and Networks Engineering Program

No	PIL Os	Themes							
		1st Theme	2nd Theme	3rd Theme	4th Theme	5th Theme	6th Theme	7th Theme	8th Theme
1	A1	N/A							
2	A2								
3	A3								
4	A4								
5	B1								
6	B2								
7	B3								
8	B4								
9	C1								

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No	PIL Os	Themes							
		1st Theme	2nd Theme	3rd Theme	4th Theme	5th Theme	6th Theme	7th Theme	8th Theme
10	C2								
11	C3								
12	C4								
13	D1								
14	D2								
15	D3								
16	D4								

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ملحق (10) موائمة مخرجات تعلم برنامج ماجستير في هندسة الاتصالات والشبكات مع المقررات

Annex (10): Mapping Program Intended Learning Outcomes with courses for Master of Science in Communications and Networks Engineering Program

Course Name	Program Intended Learning Outcomes (PIOLs)															
	(A): Knowledge and Understanding				(B): Intellectual Skills				(C): Practical and Professional Skills				(D): Transferrable Skills			
	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
Stochastic Processes																
Advanced Digital Communications																
Communication Networks																
Advanced Digital Signal Processing																
Research Methods and Project Preparation																

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Course Name	Program Intended Learning Outcomes (PIOLs)															
	(A): Knowledge and Understanding				(B): Intellectual Skills				(C): Practical and Professional Skills				(D): Transferrable Skills			
	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
Advanced Wireless and Mobile Communications																
Optical Fiber Communications																
Network Security																
Internet of Things																
Broadband Access Networks																

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Course Name	Program Intended Learning Outcomes (PIOLs)															
	(A): Knowledge and Understanding				(B): Intellectual Skills				(C): Practical and Professional Skills				(D): Transferrable Skills			
	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
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ملحق (11) موائمة مخرجات تعلم برنامج ماجستير في هندسة الاتصالات والشبكات مع المرجعيات

Annex (11): Mapping Program Intended Learning Outcomes with the benchmarks for Master of Science in Communications and Networks Engineering Program

Program Intended Learning Outcomes (PIOs)																Standards and Benchmarks
(A)				(B)				(c)				(D)				
A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4	
																N/A

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Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas			

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Program Specification

ملحق (12) مواعمة أهداف البرنامج مع مخرجات التعلم المقصودة لبرنامج ماجستير في هندسة الاتصالات والشبكات
 Annex (12): Alignment of Communications and Networks Engineering Program Objectives with Program Intended Learning Outcomes

Program Objectives رقم ونص المعيار	Program Intended Learning Outcomes (PILOs) رموز مخرجات التعلم للبرنامج															
	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
1. Develop advanced knowledge and broad understanding of the principles and methodologies of communications and networks engineering.	√	√		√	√	√					√					√
2. Apply their knowledge to design, investigate and solve complex problems in the areas of communication systems and networking.	√	√		√	√	√	√	√	√	√	√	√	√			
3. Promote scientific and applied research	√		√		√	√		√	√	√	√	√	√	√	√	

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Program Objectives رقم ونص المعيار	Program Intended Learning Outcomes (PIOs) رموز مخرجات التعلم للبرنامج															
	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
particularly that is related to development local Telecommunications companies.																
4. Develop their independent learning skills as required for continued professional development.	√	√		√	√	√	√		√	√		√		√	√	√
5. Develop high-level oral and written communication skills specific to the needs of the communication systems industry and network engineering.				√			√			√		√				√

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Program Intended Learning Outcomes (PILOs):

A. Knowledge and Understanding:

- | |
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| A1 Demonstrate advanced knowledge and understanding of mathematical methods, scientific and engineering principles, and engineering specialization relevant to communication systems and network engineering. |
| A2 Develop an understanding of the contemporary technical and professional issues in engineering. |
| A3 Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. |
| A4 Acquire and apply new knowledge as needed, using appropriate learning skills and strategies. |

B. Cognitive/ Intellectual Skills

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|--|
| B1 Model and simulate the behavior of wireless communication channels, transmitters, and receivers. |
| B2 Critically analyze and compare the performance and complexity of various technical options for mobile communication systems and networks. |
| B3 Identify, formulate, and solve complex engineering problems in communication systems and networks by using appropriate techniques, |

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technologies and/or tools.

B4 Investigate and critically evaluate current research and literature review related to specialized areas of communications and networks, industrial documentation, standards, analyze and interpret data, and use engineering judgment to draw conclusions.

C. Practical and Professional Skills

C1 Apply appropriate mathematical and computer-based methods for modeling and analyzing discipline-specific engineering problems.

C2 design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

C3 Apply alternative methods for solving engineering problems and identify advantages and disadvantages of the alternative methods.

C4 Conduct research independently and collaboratively, and produce technical reports, a master thesis, and scientific technical papers.

D. General and Transferable Skills

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- | |
|--|
| D1 Apply engineering techniques, skills, and modern engineering tools in problem solving, and make competent decisions in complex and unpredictable situations. |
| D2 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| D3 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |
| D4 Communicate technical information orally, visually, in writing, and in drawings using professional media with clear and concise arguments. |

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