32. Course Specification of Communication Principles

I. Course Identification and General Information:

1.	Course Title:	Communication Principles				
2.	Course Code & Number:	CNE221				
3.	Credit hours:	C.H				TOTAL
		Th.	Tu.	Pr.	Tr.	4
		2	2	2	-	
4.	Study level/ semester at which this course is offered:	3th Year – 2nd Semester				
5.	Pre-requisite (if any):	Statistics and Probability for Engineers (BR131), Signals and Systems (CNE216)				
6.	Co-requisite (if any):	Electronics 1 (PME113)				
7.	Program(s) in which the course is offered:	Communication Engineering and Networks				
8.	Language of teaching the course:	English				
9.	Location of teaching the course:	Faculty of Engineering, Sana'a University				
10.	Prepared By:	Dr. Mohammed Alwadeai				
11.	Date of Approval:	2020				

II. Course Description:

Communication systems lie at the heart of all modern information processes. This course covers the basic techniques employed in such systems, including their theoretical background, whether they are use in legacy AM and FM radio or the latest 4G smart phone. It covers an overview of communication system architecture/organization, the general structure of an communication system (transmitter, channels and receiver), amplitude modulation and detection (DSB-SC, DSB-LC, SSB-SC, SSB-LC and VSB), SNR in AM reception, angle modulation and demodulation, SNR in angle modulation (FM/PM reception). Signal-to-noise improvement using de-emphasis. Pulse modulation (PAM, PWM and PPM), Time-division multiplexing (TDM).

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

	III. Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1	Understand the fundamentals of Communication Systems (their components, structures and types), and the concept of communication process.	A1, A2
a2	Describe the principles of amplitude modulated and angle modulated communication systems.	
b1	Analyze communication systems in both the time and frequency domains.	B1, B2
b2	Analyze communication system performance for example in terms of bandwidth efficiency and SNR and identify some aspects of racing conditions and their solutions.	
c1	Apply suitable basic principles of communication systems and modulation method for solving the related problems.	C1, C2
c2	Design appropriate technique applied in real-life communication system.	
d1	Conduct searches on solutions for engineering problems from engineering and non-engineering domains.	D2, D3
d2	Adopt professional and ethical responsibilities.	

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1. Understand the fundamentals of Communication Systems (their components, structures and types), and the concept of communication process	▪ Active Lectures. ▪ Tutorials.	▪ Midterm and final exams ▪ Written Assessment. ▪ Quizzes.
a2. Describe the principles of amplitude modulated and angle modulated communication systems.	▪ Active Lectures. ▪ Tutorials.	▪ Midterm and final exams ▪ Written Assessment. ▪ Quizzes.

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

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1. Analyze communication systems in both the time and frequency domains.	▪ Active Lectures. ▪ Tutorials.	▪ Midterm and final exams ▪ Written Assessment. ▪ Quizzes.
b2. Analyze communication system performance for example in terms of bandwidth efficiency and SNR and identify some aspects of racing conditions and their solutions.	▪ Active Lectures. ▪ Tutorials.	▪ Midterm and final exams ▪ Written Assessment. ▪ Quizzes.

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Apply suitable basic principles of communication systems and modulation method for solving the related problems.	▪ Active Lectures, ▪ Laboratory ▪ Tutorials.	▪ Midterm and final exams. ▪ Written Assessment. ▪ Quizzes.
c2. Design appropriate technique applied in real-life communication system.	▪ Active Lectures, ▪ Laboratory ▪ Tutorials.	▪ Midterm and final exams. ▪ Written Assessment. ▪ Quizzes.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Conduct searches on solutions for engineering problems from engineering and non-engineering domains.	▪ Lectures, ▪ Problems Solving ▪ Demonstrations, ▪ Practical classes,	▪ Assignments, ▪ Homework. ▪ Reports

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

d2.	Adopt professional and ethical responsibilities.	▪ Lectures, ▪ Problems Solving ▪ Demonstrations, ▪ Practical classes,	▪ Assignments, ▪ Homework. ▪ Reports

IV. Course Content:

A. Theoretical Aspect

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1.	Introduction	a1, a2, b1, b2,c1, c2	- General introduction to modern communication and communication networks and their stages of development. - General block diagram of communication Systems. - The Transmitter (elements, structures). - Channels (types, Drawback). - The Receiver (elements, structures). - Review of: - Signals and Systems, - Orthogonality and signal representations, - Fourier analysis, - Band pass, - Power Spectral Density.	2	4
2.	Amplitude Modulation	a1, a2, b1, b2, c1, c2, d1, d2	- Amplitude Modulation: Suppressed Carrier - Generation of DSB-SC Signals - The Chopper Modulator - Use of Nonlinear Devices	4	8

			- Demodulation (Detection) of DSB-SC Signals - The Chopper Amplifier - Pilot Carrier Systems - The Phase-Locked Loop - The Scanning Spectrum Analyzer - Amplitude Modulation: Large Carrier (AM) - Carrier and Sideband Power in AM - Generation of DSB-LC Signals - The Chopper (Rectifier) Modulator - Modulator Using Nonlinearities - Demodulation (Detection) of DSB-LC Signals - The Envelope Detector - Rectifier Detector - The Tuned-Radio-Frequency (TRF) Receiver - The Superheterodyne Receiver - Single-Sideband (SSB) Modulation - Generation of SSB Signals - Analytic Signals and Hilbert Transform - Demodulation of SSB Signals - Vestigial-Sideband Modulation - A Time-Representation of Bandpass Noise		

			- Effects of Noise in AM Systems
			  - DSB-SC
			  - SSB-SC
			  - DSB-LC: The Envelope Detector
			- Propagation Effects
			- Frequency-Division Multiplexing (FDM)		

3.	Angle Modulation	a1, a2, b1, b2, c1, c2, d1, d2	- Frequency Modulation (FM) and Phase Modulation (PM) - Narrowband FM - Wideband FM - General Approximations - Sinusoidal Case - Commercial FM Transmissions - Average Power in Angle-Modulated Waveforms - Phase Modulation - Generation of Wideband FM Signals - Indirect FM - Direct FM - FM Multiplexing - Demodulation of FM Signals - Direct Method - Indirect Method: The Phase-Locked Loop - The Linearized PLL - The First-Order PLL - The Second-Order PLL - SNR in FM Reception - Threshold Effect in FM - Signal-to-Noise Improvement Using Deemphasis.	4	8

4.	Pulse Modulation	a1, a2, b1, b2, c1, c2, d1, d2	- Pulse-Amplitude Modulation (PAM)
			- Time-Division Multiplexing (TDM)
			- Pulse Shaping and Intersymbol Interference
			- Pulse-Width Modulation (PWM)
			- Pulse-Position Modulation (PPM)
			- SNR in Analog Pulse Modulation
			  - PAM
			  - Pulse-timing Modulation
			- Pulse-Code Modulation (PCM)
			- Use of Parity and Redundancy in PCM
			- Time-Division Multiplexing of PCM signals
			- The Matched Filter
			- Pseudonoise (PN) Sequences
				4	8

Number of Weeks /and Units Per Semester				**14**	**28**

B- Tutorials Aspect:

Order	Tutorial Skills List	Nº of Weeks	C.H.	CILOs
1.	**Fourier Series and Transform** - Signal Operations (Time-Shifting, Time scaling and Reflecting) - Fourier Series - Fourier transform and its properties - Energy spectral density - Power spectral density - Convolution - Correlation	2	4	a1,a2,b1,b2,c1,c2

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

2.	**Amplitude Modulation and Demodulation** - Types of AM Modulations and demodulation - Equivalent circuit of types AM modulators, demodulators, oscillators and amplifiers. - Modelica and/or MATLAB simulation of modulation and demodulation processes of types AM Systems**.**	4	8	a1, a2, b1, b2, c1, c2, d1, d2
3.	**Angle Modulation and Demodulation** - Types of Angle Modulations and demodulation. - Equivalent circuit of type Angle Modulation**.** - Modelica and/or MATLAB simulation of modulation and demodulation processes of types Angle Modulation Systems.	4	8	a1, a2, b1, b2, c1, c2, d1, d2
4.	**Pulse Modulation** - Types of PM Modulations and demodulation. - Equivalent circuit of types PM modulators. - Modelica and/or MATLAB simulation of modulation and demodulation processes of types PM Systems.	4	8	a1, a2, b1, b2, c1, c2, d1, d2
Number of Weeks /and Units Per Semester		**14**	**28**	

B- Practical Aspect:				
Order	**Tasks/ Experiments**	**Number of Weeks**	**Contact hours**	**Learning Outcomes**
1.	Introduction (Safety regulations and requirements in electrical laboratories, introduction to main laboratory devices and instrumentations, introduction to main measurement devices, reporting format)	1	2	a1, a2, b1, b2, c1, c2, d1, d2
2.	Modulation of double side-band suppressed carrier (DSB-SC)	1	2	a1, a2, b1, b2, c1, c2, d1, d2
3.	Demodulation of DSB-SC signal	1	2	a1, a2, b1, b2, c1, c2, d1, d2
4.	Modulation of double side-band large carrier (DSB-LC)	1	2	a1, a2, b1, b2, c1, c2, d1, d2
5.	Demodulation of DSB-LC signal (Envelope detector)	1	2	a1, a2, b1, b2, c1, c2, d1, d2
6.	Modulation of single side-band suppressed carrier (SSB-SC)	1	2	a1, a2, b1, b2, c1, c2, d1, d2
7.	Demodulation of SSB-SC signal	1	2	a1, a2, b1, b2, c1, c2, d1, d2
8.	Generation of frequency modulation (FM)	1	2	a1, a2, b1, b2, c1, c2, d1, d2
9.	Demodulation of FM signal	1	2	a1, a2, b1, b2, c1, c2, d1, d2
10.	Generation of phase modulation (PM)	1	2	a1, a2, b1, b2, c1, c2, d1, d2

11.	Demodulation of PM signal	1	2	a1, a2, b1, b2, c1, c2, d1, d2
12.	Pulse width modulation	1	2	a1, a2, b1, b2, c1, c2, d1, d2
13.	Analog to digital converter	1	2	a1, a2, b1, b2, c1, c2, d1, d2
14.	Laboratory final exam	1	2	a1, a2, b1, b2, c1, c2, d1, d2
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Lectures,
- Problems Solving,
- Laboratory works,
- Demonstrations,
- Practical classes,
- Simulation Tools.

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Homework.	a1, a2, b1, b2, c1,c2	Weekly	4
2.	Design and implementation of DSB-SC, DSB-LC, SSB modulators/demodulators using MATLAB.	a1, a2, b1, b2, c1,c2, d1, d2	6th	4
3.	Design and implementation of FM, PM modulators/demodulators using MATLAB.	a1, a2, b1, b2, c1,c2, d1, d2	11th	4
4.	Design of a practical project.	b1, b2, c1,c2, d1, d2	12th	4
5.	Lab-reports	a1,a2,b1,b2	Weekly	4
	Total			**20**

Head of Department Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	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

VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Quizzes	4th, 7th,10th, and 13th	20	10%	a1,a2,b1,b2
2.	Assignments & Homework, Tasks & Presentation	Weekly	20	10%	a1,a2,b1,b2,d2
3.	Mid-term Exam	7th	20	10%	a1,a2,b1,b2,c1
4.	Final Exam (Practical)	14th	30	15%	a1,a2,b1,b2,c1,c2,d2
5.	Final Exam	16th	110	55%	a1,a2,b1,b2,c1,c2
	Sum		**200**	**100%**	

VIII. Learning Resources:

Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).

1- Required Textbook(s) (maximum two).

1- Ferrel G. Stremler, Introduction to Communication Systems, 3rd Edition, Addison-Wesley, 1990.

2- Essential References.

1- S. Haykin, Communication Systems, 3rd Edition, John Wiley & Sons.
2- Martin S. Roden, Analog and Digital Communication Systems, 4th Edition, Prentice Hall Int. Inc.
3- R. E. Ziemer & W. H. Tranter, Principles of Communications, 5th Edition, Wiley.
4- Leon W. Couch, Digital and Analog Communication Systems, 5th Edition, Prentice Hall.

3- Electronic Materials and Web Sites *etc*.

1-

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

	IX. Course Policies:
1.	**Class Attendance:** - The students should have more than 75% of attendance according to rules and regulations of the faculty.
2.	**Tardy:** - The students should respect the timing of attending the lectures. They should attend within 15 minutes from starting of the lecture.
3.	**Exam Attendance/Punctuality:** - The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
4.	**Assignments & Projects:** - The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time.
5.	**Cheating:** - If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquiries.
6.	**Plagiarism:** - If one student attends the exam on another behalf; he will be dismissed from the faculty according to the policy, rules and regulations of the university.
7.	**Other policies:** - All the teaching materials should be kept out the examination hall and mobile phones are not allowed. - Mutual respect should be maintained between the student and his teacher and also among students. Failing in keeping this respect is subject to the policy, rules and regulations of the university.

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

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Asst. Prof. Dr.Mohammed Al-Suraby**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

Head of Department Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	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

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