



INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FAKULTAS TEKNOLOGI ELEKTRO DAN INFORMATIKA CERDAS
DEPARTEMEN TEKNIK ELEKTRO
Program Studi Sarjana (S1) Teknik Elektro

*INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)
FACULTY OF INTELLIGENT ELECTRICAL & INFORMATICS TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING
Bachelor Degree Program in Electrical Engineering*

1	Nama Mata Kuliah / Course Name : Sistem Komunikasi / <i>Communication Systems</i>
2	Kode Mata Kuliah / Course Code : EL234402
3	Kredit / Credits : 4 SKS
4	Semester / Semester : 5

Deskripsi Mata Kuliah / Course Description

Sistem Komunikasi membahas tentang perancangan sistem transmisi sinyal pesan (data) dalam format analog dan digital menggunakan sinyal/ gelombang pembawa dengan tujuan agar sinyal pesan analog/digital dapat dikirim melewati media transmisi (dengan gangguannya berupa interferensi dan filtering) dan gangguan berupa sinyal noise dan membahas perancangan teknik demodulasi dan deteksi sinyal pesan kembali dengan kemungkinan error sekecil mungkin dengan memperhatikan kriteria perancangan yaitu daya dan bandwidth yang efisien serta kompleksitas perangkat yang rendah. / *The Communication Systems course covers the design of message signal (analog and digital data) transmission systems using carrier signals/waves. The goal is to transmit analog/digital message signals through a transmission medium, which includes interference and filtering, as well as dealing with noise signals. The course also discusses the design of demodulation techniques and signal detection with the goal of minimizing errors while considering design criteria such as efficient power and bandwidth usage, as well as low device complexity.*

Capaian Pembelajaran Lulusan (CPL) Yang Dibebankan Mata Kuliah / Program Learning Outcomes Charged to The Course

CPL 2 Mampu mengkaji dan memanfaatkan ilmu pengetahuan dan teknologi dalam rangka mengaplikasikannya pada bidang teknik elektro, serta mampu mengambil keputusan secara tepat dari hasil kerja sendiri maupun kerja kelompok dalam bentuk laporan tugas akhir atau bentuk kegiatan pembelajaran lain yang luarannya setara dengan tugas akhir melalui pemikiran logis, kritis,

sistematis dan inovatif / *Able to examine and utilize knowledge and technology for the purpose of applying them in the field of electrical engineering, and making informed decisions based on individual work as well as group work in the form of final reports or other learning activities whose outcomes are equivalent to final projects, through logical, critical, systematic, and innovative thinking.*

CPL 5 Mampu mendesain komponen, sistem, dan proses yang logis dan realistis sesuai dengan spesifikasi yang ditentukan dengan mempertimbangkan aspek keselamatan, sosial, budaya, lingkungan, dan ekonomi / *Able to design components, systems, and processes that are logical and realistic in accordance with specified specifications, while considering safety, social, cultural, environmental, and economic aspects.*

CPL 7 Mampu mengetahui dan mengaplikasi metode, keahlian sesuai perkembangan terkini di bidang ilmu pengetahuan dan teknologi untuk menyelesaikan permasalahan teknik elektro dengan mengedepankan nilai-nilai universal / *Able to understanding and applying the latest methods and skills in the field of science and technology to solve electrical engineering problems while emphasizing universal values.*

Capaian Pembelajaran Mata Kuliah / *Course Learning Outcomes*

1. Mampu memahami dan mendefinisikan konsep sistem komunikasi analog dan digital, mampu menerapkan konsep sinyal dan sistem dalam analisis sistem komunikasi serta mampu menjelaskan konsep pengubahan sinyal analog menjadi sinyal digital. / *Capable of understanding and defining the concepts of analog and digital communication systems, applying the concepts of signals and systems in communication system analysis, and explaining the concept of converting analog signals into digital signals.*
2. Mampu memahami konsep modulasi amplitudo dan demodulasi sinkron (koheren), mampu menganalisa kinerjanya dalam gangguan derau, dan mampu melakukan simulasi proses modulasi amplitudo (analog) dan demodulasi sinkron (koheren) menggunakan software Matlab, serta mampu mengaplikasikan konsep pergeseran frekuensi dan fasa untuk aplikasi penting lainnya dalam menunjang transmisi sinyal secara analog yang hemat bandwidth dan aman. / *Able to comprehend the concept of amplitude modulation and coherent demodulation, analyze their performance in the presence of noise, simulate amplitude modulation (analog) and coherent demodulation (coherent) processes using Matlab software, and apply the concepts of frequency and phase shifting for other important applications that support efficient and secure analog signal transmission.*
3. Mampu menjelaskan konsep pengubahan sinyal analog menjadi sinyal digital, mampu memahami konsep dasar penerima optimum untuk sistem komunikasi digital dan mampu memahami konsep ruang sinyal dan aplikasinya dalam perancangan pemancar dan penerima optimum untuk sistem modulasi digital biner dan m-ary, dan mampu menggunakan program matlab untuk simulasi dan analisis sistem komunikasi digital, serta mampu menjelaskan konsep perhitungan kinerja sistem komunikasi digital pada kanal ideal dengan gangguan interferensi derau putih Gaussian. / *Capable of explaining the concept of converting analog signals into digital signals, understanding the basic*

principles of optimal receivers for digital communication systems, comprehending the concept of signal space and its application in designing optimal transmitters and receivers for binary and m-ary digital modulation systems, and using Matlab programs for simulation and analysis of digital communication systems. Additionally, able to explain the concept of performance calculations for digital communication systems in an ideal channel with interference and Gaussian white noise.

4. Mampu merancang bentuk spektrum dan pulsa sinyal modulasi digital linier sehingga dapat dioperasikan pada lingkungan terbatas bandwidth dan mampu merancang teknik ekualiser sederhana untuk mengatasi adanya distorsi inter-symbol-interference akibat kanal tak ideal. / *Able to design the spectral shape and pulse of linear digital modulation signals so they can operate within a limited bandwidth environment, and design simple equalization techniques to mitigate inter-symbol interference distortion due to non-ideal channels.*

Pokok Bahasan / Contents

1. Konsep sistem komunikasi analog dan digital, Review sinyal dan sistem : Konsep sinyal dan spektrum sinyal komunikasi: konsep sinyal energi dan sinyal daya, pengertian dan bandwidth sinyal baseband dan sinyal passband, Okorelasi dan rapat spektral daya. / *Concepts of analog and digital communication systems, Signal and system review: Signal and signal spectrum concepts, energy signals, and power signals, understanding signal bandwidth and baseband/passband signals, autocorrelation and power spectral density.*
2. Konsep transmisi ideal, respon impuls kanal ideal dan kanal non ideal. Bandwidth dan efek filtering kanal, distorsi kanal fading dan ekualiser serta penyaringan kuadratur dan transformasi Hilbert. / *Ideal transmission concepts, ideal channel impulse response, and non-ideal channels. Bandwidth and channel filtering effects, channel distortion, fading, equalization, quadrature filtering, and Hilbert transformation.*
3. Konsep modulasi dan demodulasi amplitudo : DSB, AM, SSB dan VSB dan konsep modulasi untuk aplikasi lainnya seperti multipleksing dan scrambling serta konsep penggunaan perangkat ICT untuk mensimulasikan modulasi dan demodulasi analog menggunakan software Matlab. / *Amplitude modulation and demodulation concepts: DSB, AM, SSB, and VSB, and modulation concepts for other applications like multiplexing and scrambling. Also, the concept of using ICT devices for simulating analog modulation and demodulation using Matlab software.*
4. Konsep perhitungan kinerja sistem komunikasi analog dalam lingkungan AWGN. / *Performance calculation concepts for analog communication systems in an Additive White Gaussian Noise (AWGN) environment.*
5. Konsep konversi sinyal pesan analog menjadi sinyal pesan digital. / *Concepts of converting analog message signals into digital message signals.*
6. Konsep penerima optimum sinkron/koheren sistem komunikasi digital: Penerima Matched Filter dan korelator, detektor maximum likelihood. / *Concepts of synchronous/coherent digital communication system optimal receivers: Matched Filter receivers and maximum likelihood detectors.*
7. Konsep ruang sinyal dan representasi set sinyal berdurasi terbatas , dan prosedur Gram-Schmidt untuk mendapatkan sinyal basis orthonormal. / *Signal space concepts*

and representation of finite duration signal sets, and the Gram-Schmidt procedure to obtain orthonormal basis signals.

8. Konsep perancangan penerima koheren dan pemancar untuk sistem komunikasi digital biner. / *Concepts of designing coherent receivers and transmitters for binary digital communication systems.*
9. Konsep simulasi dari sistem komunikasi digital biner menggunakan software Matlab. / *Simulation concepts for binary digital communication systems using Matlab software.*
10. Konsep perancangan penerima koheren dan pemancar untuk sistem komunikasi digital M-ary. / *Concepts of designing coherent receivers and transmitters for M-ary digital communication systems.*
11. Konsep simulasi dari sistem komunikasi digital Biner dan M-ary menggunakan software Matlab. / *Simulation concepts for binary and M-ary digital communication systems using Matlab software.*
12. Konsep perhitungan kinerja BER sistem komunikasi digital biner. / *Concepts of Bit Error Rate (BER) performance calculation for binary digital communication systems.*
13. Konsep perhitungan kinerja SER dan BER sistem komunikasi digital M-ary. / *Concepts of Symbol Error Rate (SER) and BER performance calculation for M-ary digital communication systems.*
14. Konsep perhitungan rapat spektral sinyal modulasi linier dan teknik pulse-shaping dan teknik koding. / *Concepts of linear modulation signal power spectral density calculations and pulse shaping techniques and coding techniques.*
15. Konsep pengiriman sinyal modulasi digital dengan bandwidth terbatas dan terbebas inter-simbol interferensi (ISI) menggunakan filtering Nyquist dan konsep ekualisasi kanal untuk menurunkan ISI karena pengaruh kanal tak-ideal. / *Concepts of transmitting digital modulation signals with limited bandwidth and mitigating Inter-Symbol Interference (ISI) using Nyquist filtering and channel equalization to compensate for non-ideal channel effects.*

Prasyarat / Pre-requisite

Sinyal dan Sistem, Pengolahan Sinyal Digital, Proses Stokastik / *Signals and Systems, Digital Signal Processing, Stochastic Processes*

Pustaka / Reference

1. Hwei Hsu, Ph.D., Schaum's outline of theory and problems of Analog and Digital Communications, 2nd Edition, Mc-Graw Hill, 2003.
2. Bernard Sklar and Pabitra Kumar Ray, Digital communications: Fundamentals and Applications, 2nd Edition, PEARSON, 2014.
3. John G. Proakis, Digital communications, 3rd Edition, Mc-Graw Hall, 1995.
4. Hiroshi Harada, Ramjee Prasad, " Simulation and Software Radio for Mobile Communications" Artech House, LONDON, 2002
5. Tri T. Ha, Theory and Design of Digital Communication Systems, cambridge University Press, 2011.
6. Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan. Simulation of communication systems: modeling, methodology and techniques, 2nd Edition, Kluwer Academic Publishers, New York, 2002.