Dokumen Kurikulum 2013-2018

Program Studi : Teknik Elektro

Lampiran I

Sekolah Teknik Elektro dan Informatika

Institut Teknologi Bandung

	Bidang Akademik dan Kemahasiswaan **Institut Teknologi Bandung**	**Kode Dokumen**		**Total Halaman**
		Kur2013-S1-EL		[*165*]
		Versi	[*4*]	05 September 2013

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL4131	**3**	*7*	Biomedika	Wajib

Nama Matakuliah	Anatomi dan Fisiologi
	Anatomy and Physiology
Silabus Ringkas	Introduksi, Mekanisme Fisiologi Dasar, Sistem Kontrol Tubuh; Sistem Saraf, Sistem Lokomotorik; sistem skeletal, system muscular, Sistem Distribusi dan Pertukaran; Sistem cardiovascular, Sistem Respirasi, Sistem Urinari, wrap up & Pengayaan
	Introduction, Basic Physiology Mechanism, Integration & Control System; Nervous System, Loco-motoric system: skeletal system, muscular system, Exchange & distribution; Cardiovascular System, Respiratory System, Urinary System, wrap up & enhancement
Silabus LengkapIntroduction: level	Introduksi; orientasi dan level organisasi, kaitan Anatomi dan Fisiologi terhadap bidang engineering, parameter dan sinyal fisiologi, homeostasis. Mekanisme Fisiologi Dasar; Sel, transpor melalui membrane dan potensial membrane. Sistem integrasi dan Kontrol Tubuh; Organisasi selular Sistem Saraf, system saraf pusat dan perifer, sinaps Sistem Lokomotorik; sistem skeletal, jaringan dan fisiologi otot, system muscular. Sistem Distribusi dan Pertukaran; Sistem cardiovascular (organisasi dan fungsi, kelistrikan, mekanikal proses, vascular & hemodinamika, kontrol). Sistem Respirasi (organisasi dan fungsi, mekanikal properti, pertukaran dan transport gas, kontrol). Sistem Urinari ((organisasi dan fungsi, nefron dan fungsi dasar ginjal, peran ginjal pada homeostasis), wrap up & Pengayaan
	Introduction; orientation & organization level, relationship Anatomy & Physiology with biomedical engineering, physiological signal & parameter, homeostasis Basic Physiology Mechanism; cellular membranes and transport , membrane potential, cell communication, human body electricity Integration and Control System of the human body; Cellular organization of Nervous System , Central & Peripheral Nervous System, synaps Locomotoric System; Skeletal System, muscle tissue & physiology, muscular Sysytem Exchange and Distribution: Cardiovascular System (organization & function, electrical activity, mechanical event, vascular & hemodynamic, control). Respiratory System (organization & function, mechanical propertis, gas exchange & transport , control). Urinary system ((organization & function, Nefron & basic renal function, homeostatic) , wrap-up
Luaran (Outcomes)	Setelah mengikuti mata kuliah ini mahasiswa selayaknya memiliki kemampuan: - Mengerti dan mampu menerangkan konsep serta terminologi dasar anatomi dan fisiologi manusia - Mampu menggunakan pengetahuan dasar anatomi & fisiologi tubuh manusia sebagai acuan kerangka berpikir dalam mempelajari lebih dalam mengenai bidang terkait, seperti sistem tubuh tertentu, farmakologi, dsb. - Mampu menggunakan pengetahuannya dalam anatomi & fisiologi tubuh manusia sebagai acuan kerangka berpikir dalam melakukan penelitian/desain terkait biomedika di bidang ilmu masing- masing, sebagai contoh: o MahasiswaTeknik Elektro & Teknik Fisika: merancang instrumentasi biomedika dengan menggunakan prinsip-prinsip anatomi dan fisiologi manusia o Mahasiswa Teknik Informatika: membuat program simulasi kerja fisiologi manusia o Mahasiswa Teknik Mesin: aplikasi dalam bidang biomekanika o Mahasiswa Matematika: mengembangkan pemodelan matematika dari sistem hidup o Mahasiswa Kimia /Teknik Kimia: sebagai dasar mempelajari biokimia atau bidang terkait o Mahasiswa Teknik Farmasi: sebagai dasar mempelajari farmakologi
Matakuliah Terkait	KI1202 KimiaDasar IIB — Prasyarat
	[*Kode dan Nama Matakuliah*] — [*Prasyarat, bersamaan, terlarang*]
Kegiatan Penunjang	Peragaan pemeriksaan sinyal-sinyal fisiologis
Pustaka	Widmaier, Raff, Strang, Vander's Human Physiology -The Mechanisms of Body Function, 12th edition, McGrawHill, 2011 (Pustaka utama)
	Joseph J Feher,Quantitative Human Physiology: An Introduction, 1th Academic Press, 2012 (Pustaka pendukung)
	3. http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2
Panduan Penilaian	Penilaian dilakukan berdasarkan nilai dari kuis, tugas, ujian mid-semester, serta ujian akhir
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduksi	a.Definisi, terminologi, kerangka referensi anatomis b. Ruang lingkup anatomi & fisiologi c. Kaitan anatomi & fisiologi terhadapTeknik Biomedika d. Organisasi tubuh manusia secara structural & fisiologis (system organ) e. homeostasis f. Karakteristik kehidupan g. Parameter dan Sinyal Fisiologi	• Mengetahui definisi anatomi dan fisiologi serta hubungan antara anatomi dan fisiologi • Mengetahui istilah anatomi untuk menjelaskan bagian, regio serta rongga tubuh, dan posisi relatif • Mengetahui fisiologi merupakan '*core*' masalah bagi Teknik Biomedika • Mengetahui analogi sistem fisiologis terhadap sistem engineering • Memahami kemungkinan aplikasi engineering terhadap tubuh manusia • Dapat mengidentifikasikan level organisasi dari organisme, sistem organ pada manusia serta komponen-komponennya • Memahami konsep, mekanisme serta regulasi homeostasis serta pentingnya bagi kehidupan • Mengetahui karakteristik kehidupan organisme • Mengetahui berbagai jenis sinyal yang terdapat pada tubuh manusia	Pustaka 1, bab 1, sub-bab 1-8 Pustaka 2, bab 1, sub-bab 1 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu I
2	Mekanisme Fisiologis Dasar	a. Sel dan Membran Sel b. transpor trans membran	a. Mengetahui struktur lokasi dan fungsi plasma membran b. Menjelaskan berbagai mekanisme transpor material melalui membran c. Menjelaskan prinsip fisika & kimia yang mendasari proses difusi, osmosis	Pustaka 1. Bab 3, sub bab1, 2 Pustaka 1, bab 4, sub bab1-5 Pustaka 2, bab2 sub bab 1, 5, 6, 7, 8 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu II
3	Mekanisme Fisiologis Dasar	c. Komunikasi antar sel d. Kelistrikan pada tubuh manusia	a. Menjelaskan mekanisme komunikasi antar sel b. Menjelaskan prinsip dasar kelistrikan pada tubuh manusia, c. Menjelaskan asal, konduksi potensial aksi	Pustaka 1. Bab 3, sub bab1, 2 Pustaka 1, bab 4, sub bab1-5 Pustaka 2, bab2 sub bab 1, 5, 6, 7, 8 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu III
4	Sistem Kontrol dan Integrasi Tubuh: Sistem Saraf	Komponen, Organisasi dan Fungsi system saraf	Menjelaskan komponen, organisasi sistem saraf	Pustaka 1. Bab 6 Pustaka 4, bab2 sub bab 1, 4, http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu III
5	Sistem Kontrol Tubuh: Sistem Saraf	Sinaps Aplikasi engineering pada system Saraf	mengetahui mekanisme transmisi sinyal pada sinap Memahami kemungkinan aplikasi engineering terhadap sistem kontrol, dengan sistem EEG sebagai contoh	Pustaka 1. Bab 6 Pustaka 2, bab 4, sub bab 2 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu V
6	Sistem Musculoskeletal: Sistem Skeletal	Komponen, organisasi dan fungsi sistem skeletal	Mengetahui organisasi dan fungsi system skeletal	http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, , materi kuliah minggu VI
7	Sistem Musculoskeletal: Sistem Muscular	Komponen, organisasi dan fungsi system muscular Jaringan otot Motor unit Sliding filament theory & kontrol Kelistrikan pada system muscular Aplikasi teknologi pada system musculoskeletal	Mengetahui organisasi otot skeletal dan fungsinya Memahami terjadinya kontraksi pada tingkat jaringan beserta mekanisme pengontrolannya Mengetahui neuromuscular junction, motor unit recruitment, excitation-contraction-couplng Memiliki wawasan mengenai aplikasi teknologi dalam sistem muscular, khususnya EMG	Pustaka 1, bab 9 Pustaka 2, bab 3 sub bab 4,5,6 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu VII
8	Sistem Kardiovaskular	Komponen dan organisasi secara keseluruhan Jantung sebagai	Mengetahui struktur dan fungsi system kardiovaskular Mengetahui siklus jantung & hubungannya dengan kelistrikan	Pustaka 12, bab 9 Pustaka 2, bab 5 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2,

		sistem Listrik Sistem Kardiovaskular sebagai sistem mekanik Siklus jantung; Jantung sebagai pompa	dan suara jantung Memahami struktur, fungsi dan cara kerja jantung Mengetahui karakteristik potensial aksi pada sel otot jantung, sistem konduksi jantung, bagian gelombang EKG dan hubungannya dengan kontraksi jantung	materi kuliah minggu VIII
9	Sistem Kardiovaskular	Sistem Vaskular & Hemodinamika Regulasi fungsi jantung Aplikasi teknologi pada system cardiovascular ECG & Pacemaker	Memahami struktur dan fungsi sistem vaskuler Memahami variabel sistem hemodinamik: volume, flow, pressure Memahami mekanisme kontrol jantung; regulasi intrinsik dan ekstrinsik Memiliki wawasan mengenai aplikasi teknologi dalam sistem kardiovaskular, khususnya EKG & Pacemaker	Pustaka 1, bab 9 Pustaka 2, bab 5 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu IX
10	Sistem Respirasi	Komponen dan organisasi system respirasi Proses mekanis pernafasan	Mengetahui komponen dan fungsi system respirasi Memahami proses masuk keluarnya udara beserta factor-faktor yang mempengaruhinya Memahami variabel dan fungsi sistem mekanik respirasi: pressure-volume relationship dan compliance dari sistem	Pustaka 1, bab 13 Pustaka 2, bab 6 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu X
11	Sistem Respirasi	Proses dan Pertukaran gas Transpor gas Aplikasi teknologi pada system respirasi: ventilator	Memahami proses pertukaran gas antara alveoli dan darah Memahami mekanisme perjalanan gas dari paru ke jaringan dan dari jaringan ke paru Memiliki wawasan mengenai aplikasi teknologi dalam sistem respirasi, khususnya ventilator dan alat pengukuran fungsi pernafasan	Pustaka 1, bab 13 Pustaka 2, bab 6 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu XI
12	Sistem Urinari	Komponen dan organisasi system urinary Nefron dan fungsi renal dasar	Memahami komponen dan fungsi sisten urinari Memahami proses pembentukan urin dan kerja ginjal: filtrasi, reabsorpsi, osmosis & counter-current multiplier system	Pustaka 1, bab 14 Pustaka 2, bab 7 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu XII
13	Sistem Urinari	Peran system urinary dalam system homeostasis Aplikasi teknologi pada system urinary: hemodialsisa	Memahami bagaimana tubuh menjaga kesetimbangan cairan : control osmolaritas, volume Memiliki wawasan mengenai aplikasi teknologi dalam sistem urinari, khususnya mesin hemodialisa	Pustaka 1, bab 14 Pustaka 2, bab 7 http://biomed.ee.itb.ac.id/kuliah/course/view.php?id=2, materi kuliah minggu XIII
14	Pengayaan	*Integrated Physiology: Distribution & exchange*	Memahami interaksi system kardiovaskular, respirasi dan urinari dalam mendistribusikan nutrisi dan *waste product*	
15	Resume			

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4239	***Bobot sks:*** **3**	***Semester:*** 8	***KK / Unit Penanggung Jawab:*** Biomedika	***Sifat:*** Pilihan
Nama Matakuliah	Fenomena Transpor di Biomedika			
	Transport Phenomena in Biomedical Engineering			
Silabus Ringkas	Deskripsi kuantitatif transportasi momentum (aliran viskos) dan transportasi massa (konveksi dan difusi) dalam sistem hidup. Penerapan metode rekayasa untuk permodelan dan pengukuran aspek-aspek dalam teknik biomedika.			
	The quantitative description of momentum transport (viscous flow) and mass transport (convection and diffusion) in living systems. Application of engineering methods to model and quantify aspects of biomedical engineering.			
Silabus Lengkap	Perpindahan energi, massa dan momentum sangat penting untuk sistem biologi. Dalam kuliah ini akan dikembangkan deskripsi kuantitatif proses transportasi dalam system biologi yang berskala spasial dari yang kecil ke besar. Kita akan belajar bagaimana menerapkan prinsip-prinsip transportasi massa dan panas ke sistem biologis, untuk memecahkan masalah yang berkaitan dengan perpindahan massa dan panas dan menggunakan alat komputasi untuk memecahkan masalah.			
	The transport of energy, mass and momentum are essential to biological system. In this course we will develop a quantitative description of transport processes from small to large spatial scale of biological systems. We will learn how to apply mass and heat transport principles to biological systems, to solve problems related to mass and heat transfer and to use computational tools to solve problem.			
Luaran (Outcomes)	1. Memahami model matematis proses transportasi massa dan energi. 2. Mampu menggunakan model transportasi massa dan energi dalam sistem biologis. 3. Mampu menggunakan metode komputasi untuk penyelesaikan masalah transportasi dalam sistem biologis berskala besar.			
Matakuliah Terkait	MA2074 Matematika Teknik II		Prasyarat	
Kegiatan Penunjang				
Pustaka	1. Basic Transport Phenomena in Biomedical Engineering, second edition, by Ronald L. Fournier. (*Pustaka utama*)			
	2. Transport Phenomena, second edition, by BSL (*pendukung*)			
	3. Transport Phenomena in Biological Systems, first edition, by GA Truskey et. al., (*pendukung*)			
Panduan Penilaian	Tugas 20%, Proyek Akhir 25%, UTS 25%, UAS 30%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pengantar Kuliah	Pengenalan mata kuliah Review unit dan dimensi Konservasi massa dan momentum		Bab 1 [1]
2	Permodelan transportasi massa dan energi	Transportasi: Momentum, Energi, Mass Solution Persamaan Transpor		Bab 2 [1]
3	Permodelan transportasi massa dan energy (2)	Latihan menyelesaikan persamaan transpor		
4	Solusi model transpor dengan metode komputasi	Menggunakan program opensource FreeFem++		
5	Sifat fisika cairan tubuh dan membran sel			Bab 3 [1]
6	Fisika Aliran Darah	Reologi darah		Bab 4 [1]
7	Fisika Aliran Darah (2)	Aliran darah		Bab 4 [1]
8	Fisika Aliran Darah (3)	Teori *Boundary layer* Pipa kapiler		Bab 4 [1]
9	UTS			
10	Transportasi larutan dalam sistem biologi	Diffusi larutan Transportasi larutan dengan filtrasi kapiler		Bab 5 [1]
11	Transportasi larutan dalam sistem biologi (2)	Permeabilitas larutan Transportasi membran		Bab 5 [1]
12	Transportasi larutan dalam sistem biologi (3)	Transportasi larutan melalui dinding kapiler		Bab 5 [1]
13	Transportasi oksigen dalam sistem biologi			Bab 6 [1]
14	Presentasi Proyek Akhir			
15	UAS			

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4125	***Bobot sks:*** ***3***	***Semester:*** ***7***	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Pengolahan Citra Digital			
	Digital Image Processing			
Silabus Ringkas	Pendahuluan, Sistem 2D dan review matriks, Peningkatan kualitas citra, Restorasi citra, Segmentasi citra, Rekonstruksi citra hasil proyeksi, Pemampatan citra, Ekstraksi fitur, Pengenalan pola			
	Introduction, 2D System and matrix review, Image enhancement, Image restoration, Image Segmentation, Image reconstruction from projection, Image compression, Feature extraction, Pattern Recognation			
Silabus Lengkap	Pengenalan pengolahan citra: masalah, aplikasi. Persepsi citra: *brightness*, *contrast*, *color*, tekstur. Sistem matriks 2D konvolusi. Transformasi citra: *Digital Fourier Transform* , *Digital Cosine Transform*. Peningkatan kualitas citra: operasi titik dan spasial. Restorasi citra: *filtering, noise suppression*. Analisis citra dan penglihatan komputer (*computer vision*). Ekstraksi ciri. Operasi morfologi. Klasifikasi citra. Rekonstruksi citra. Kompresi data citra. Studi kasus: aplikasi medis, praktikum: hands-on → Matlab, image processing toolbox. Tugas besar.			
	Introduction to Image Processing: problems, applications. Image Perception: brightness, contract, color, texture. 2D system matrix, convolution. Image transform: DFT, DCT. Image enhancement: point & spatial operation. Image restoration: filtering, noise suppression. Image analysis & computer vision. Feature extraction. Morphological operations. Image classification. Image reconstruction. Image compression. Case study: medical applications, hands-on lab works.			
Luaran (Outcomes)	1. Memahami ruang lingkup pengolahan citra digital, khususnya di bidang medis dan biologi. 2. Memahami secara teori dan mengimplementasikan aspek dari dasar teknik pengolahan citra digital. 3. Mampu menganalisis masalah pengolahan citra dan merancang solusinya menggunakan teknik pengolahan citra digital 4. Mampu mengidentifikasi implementasi terkini dari pengolahan citra, terutama di bidang medis dan biologi.			
Matakuliah Terkait	EL3010 Pengolahan Sinyal Digital		Prasyarat	
Kegiatan Penunjang	Praktikum, Kunjungan ke Klinik/RS			
Pustaka	1. RC. Gonzalez & RE Woods, Digital Image Processing 3rd Ed, Prentice Hall, 2007 (Pustaka utama)			
	2. Jain, Anil K., Fundamentals of Digital Image Processing, Prentice Hall International, 1989, (Pustaka alternatif)			
	3. Castleman, Kenneth R. Digital Image Processing. Prentice Hall International. 1996. (Pustaka pendukung)			
Panduan Penilaian	Praktikum 20%, Tugas 20 %, UTS 30%, UAS 30 %			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pendahuluan	Perkenalan: jadwal kuliah, ruang lingkup, skema penilaian	Mahasiswa memahami aturan perkuliahan: jadwal kuliah, ruang lingkup, danskema penilaian	Bab 1 [1]
2	Dasar-dasar citra digital (persepsi citra dan warna; pencuplikan dan kuantisasi citra)	Persepsi citra & warna, penangkapan citra oleh mata, akusisi citra. Pencuplikan 1D dan 2D, laju Nyquist, kuantisasi, pengkuantisasi tanpa memori, ilustrasi efek kuantisasi.	Mahasiswa memahami dasar-dasar citra digital: • Persepsi citra, penangkapan citra oleh mata, garis besar anatomi dan fungsi mata, konsep intensitas dan warna, representasi warna citra, model penglihatan, kriteria fidealitas citra • Proses pencuplikan (*sampling*), kuantisasi citra beserta batasannya, serta representasi citra citra digital	Bab 3 [1]
3	Sistem 2D dan review matriks	Notasi dan defines, fungsi delta Dirac dan Kronecker, sistem linear 2D. Matriks, matriks Toeplitz dan circulant, matriks orthogonal dan uniter.	Mahasiswa memahami system 2D, mengingat ulang konsep matriks dan operasinya, serta mengenal beberapa matriks khusus dalam pengolaha citra (Toeplitz, circulant, orthogonal, dan uniter)	Bab 2 [2]
4	Transformasi citra (I)	Transformasi orthogonal dan uniter 2D, sifat ortonormal dan lengkap, transformasi uniter terpisahkan, citra basis.	Mehasiswa memahami konsep transformasi orthogonal dan uniter, konsep dan sifat-sifat transformasi uniter terpisahkan, citra basis, serta konsep dekomposisi cira ke dalam himpunan citra basisnya	Bab 2 [1]
5	Transformasi citra (II)	Transformasi Fourier diskrit 2D, sifat-sifat transformasi Fourier Diskrit, beberapa macam transformasi citra.	Mahasiswa memahami konsep Transformasi Fourier Diskrit, baik untuk sinyal 1D maupun 2D; memahami konsep dekomposisi citra ke dalam citra-citra basisnya, serta mengenal berbagai macam transformasi 2D untuk citra beserta sifat-sifatnya (transformasi sinus diskrit, transformasi kosinus diskrit, transformasi Haar, transformasi Slant, transformasi KL)	Bab 5 [1]
6	Perbaikan citra (I)	Pemodelan citra, ekualisasi histogram, operasi spasial, pengaruh *blurring* pada operasi *low pass filter*, pengaruh derah pada berbagai tingkat energy	Mahasiswa memahami konsep dan beberapa teknik dasar dalam perbaikan citra (*image enhancement*)	Bab 7 [1]
7	Perbaikan citra (II)	Filter median, penajaman citra, operasi *high pass filter*, deteksi tepi. Perbaikan citra dalam kawasan frekuensi, filter ideal, filter Butterworth	Mahasiswa memahami berbagai teknik lanjutan dalam perbaikan citra, meliputi filter median, operator HPF, deteksi tepi, serta perbaikan melalui *filtering* dalam kawasan frekuensi.	Bab 7 [1]
8	Pemulihan citra (I)	Model proses degradasi dan restorasi citra; Model derau; Pemulihan citra akibat derau spasial; Pemuliahn citra akibat derau periodik.	Mahasiswa memahami konsep degradasi citra (*image degradation*) dan pemulihan citra (*image restoration*), model derau yang umum dijumpai pada citra digital, teknik pemulihan citra dalam kawasan spasial, serta teknik pemulihan citra akibat derau periodic dalam kawasan frekuensi.	Bab 8 [1]
9	Pemulihan citra (I)	Inverse filter, Pseudo inverse filter, Wiener filter.	Mahasiswa memahami beberapa teknik lanjutan dalam pemulihan citra, yaitu *inverse filter, pseudo-inverse filter*, dan minimu MSE filter (*wiener filter*), beserta kelebihan dan kekurangannya.	Bab 9 [1]
10	Operasi morfologi	Konsep dasar pengolahan citra morfologi, dilasi dan erosi, *opening* dan *closing*, operasi morfologi lainnya, operasi morfologi untuk citra non-biner.	Mahasiswa memahami konsep dasar pengolahan citra menggunakan operator morforlogi pada citra biner, beberapa operator dasar (dilasi, erosi, *opening, closing*), beberapa operator lain (*thinning, thickening,* skeleton), serta perluasan konsep operasi morfologi terhadap citra non-biner.	Bab 9 [1]
11	Rekonstruksi citra hasil proyeksi	Geometri proyeksi, Transformasi Radon, operator proyeksi-balik (*back-projection*). Teorema irisan proyeksi, *Inverse Radon Transform*, metoda rekonstruksi aljabar.	Mahasiswa memahami konsep rekonstruksi citra hasil proyeksi: • Geometri proyeksi (berkas parallel, kipas, dan kerucut) • Konsep pencitraan dengan proyeksi. • Transformasi Radon dan sifat-sifatnya, operator proyeksi balik, tapis proyeksi balik (RamLak, Shepp-Logan, low pass cosine dan generalized Hamming). • Teorema irisan proyeksi. • Rekonstruksi proyeksi dengan *Inverse Radon Transform*, dan rekonstruksi proyeksi dengan metoda aljabar.	Bab 9 [2]

12	Pemampatan data citra	Pengantar kompresi citra, laju informasi, *pixel coding, predictive coding, transform coding, color coding*	Mahasiswa memahami prinsip-prinsip kompresi/pemampatan data citra (*image data compression*), serta mengerti beberapa teknik dasar yang umum digunakan: *pixel coding (PCM, entropy coding, RLE, bit plane encoding), predictive coding (DPCM), transform coding,* serta *color/multispectral image coding.*	Bab 20 [3]
13	Dasar-dasar pengenalan pola	Konsep pengenalan pola, uji nisbah *likelihood* dan variasinya, peluang kesalahan, resiko Bayes, kriteria Bayes, fungsi diskriminan.	Mahasiwa memahami konsep pengenalan pola, serta aplikasinya bersama pengolahan citra dalam berbagai bidang; mengingat kembali konsep teori peluang dan aljabar linier, serta hubungan keduanya dengan teknik pengenalan pola; serta mengerti teori keputusan Bayes dan aplikasinya dalam pengenalan pola.	Bab 10 [1]
14	Studi kasus	Pengolahan citra untuk aplikasi medis	Mahasiswa memahami dan mampu menerapkan konsep dan materi pengolahan citra yang sudah disampaikan dalam sebuah persoalan medis.	
15	Tugas besar	Konsultasi dan Tanya-jawab seputar topik tugas yang dikerjakan secara berkelompok	Mahasiswa memahami kembali materi ajar yang telah disampaikan, menerapkannya dalam sebuah persoalan, memberikan analisis yang sesuai, serta menyampaikannya dalam bentuk laporan/presentasi tugas besar.	Sumber2 yang relevan, internet, dll

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi : Teknik Elektro
Fakultas : Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL4240	*3*	*8*	Biomedika	Pilihan

Nama Matakuliah	Pengukuran Biosinyal
	Biosignal Measurement
Silabus Ringkas	Pengenalan karakteristik biosinyal dan proses pengukuran biosinyal berbasis komputer
	A course to introduce students to the realm of biological signals and their analysis using common tools of modern computer-based signal handling.
Silabus Lengkap	Topik kuliah mencakup : - Sistem pengukuran biosinyal, - Jenis dan karakteristik biosinyal, - Akuisisi data biosinyal - Pengukuran biosinyal berbasis komputer - Teknik dasar pemrosesan biosinyal (Fourier transform, FIR, Moving average, Wavelet transform) - Analisis spektrum - Data filtering and Wave-shaping - Analisis, ekstraksi dan interpretasi biosinyal. Studi kasus : ECG, EEG, dan EMG
	-
Luaran (Outcomes)	1) Dapat mengklasifikasikan jenis biosinyal berdasarkan beberapa fitur 2) Dapat melakukan perekaman berbagai jenis biosinyal 3) Dapat menerapkan teknik dasar yang biasa digunakan untuk pemrosesan biosinyal 4) Dapat melakukan analisisis terahadap data biosinyal untuk mendapatkan informasi diagnosa 5) Dapat mengukur parameter biosinyal terkait 6) Dapat menginterpretasikan hasil ekstraksi parameter suatu biosinyal Upon completion of the subject, students will be able to: - Classify biomedical signals into different categories according to various features; - Perform various biosignal recording - Apply basic signal processsing technique involved in biosignal processing - Analyze recorded biosignal to derive diagnostic information - Measure related biosignal parameters - Interpret extracted parameters from measured biosignal
Matakuliah Terkait	EL4131 Anatomi Fisiologi — Prasyarat
	EL3010 Pengolahan Sinyal Digital — Prasyarat
Kegiatan Penunjang	Praktikum
Pustaka	[*Rangaraj R. Rangayyan, Biomedical Signal Analysis : A Case Study Appraoach, John Wiley & Sons Inc., 2002*] (Pustaka utama)
	[*John M. Semlow, Biosignal and Biomedical Image Processing, John Wiley & Sons Inc., Edisi, Penerbit, Tahun terbit*] (*Pustaka alternatif*)
	[*Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing, dapat diakses secara online di laman : http://www.dspguide.com/pdfbook.htm*] ([*Pustaka pendukung*])
Panduan Penilaian	- Homework assignment - Lab Performace and Report - Mid-term Exam - Final Exam
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pendahuluan	- *Sistem Pengukuran biosinyal*	- *Mahasiswa dapat menjelaskan proses pengukuran biosinyal secara umum dan impaknya terhadap diagnossuatu penyakit*	Semmlow – Ch.1
2	*Jenis dan Karakteristik Biosinyal*	- *Biopotensial* - *Bentuk Waveform* - *Karakteristik fisiologi* - *Komponen utama sinyal* - *Spectrum frekuensi sinyal*	- *Mahasiswa dapat menjelaskan berbagai karakteristik suatu biosinyal*	*Rangayyan – Ch.1*
3	*Akuisisi Data Biosinyal*	- *Bioelektroda* - *Sensor dan Tranducer* - *Analog amplifier* - *Analog to Digital Converter*	- *Mahasiswa dapat menjelaskan proses pengambilan data biosinyal dari sebuah sistem instrumentasi biomedik* - *Mahasiswa dapat menjelaskan karakteristik tranducer untuk pengambilan biosinyal*	*Semmlow – Ch.1*
4	*Pengukuran Biosinyal berbasis Kompouter*	- *Pengenalan tools BIOPAC* - *Pengenalan MATLAB*	- *Mahasiswa dapat menggunkan perangkat berbasis komputeruntuk pengukuran biosinyal* - *Mahasiswa mengenal software komputasi untuk memproses biosinyal*	
5	*Pengenalan Teknik Pemrosesan Biosinyal*	- *Fourier transform, FIR, Moving average, Wavelet Transform*	- *Dapat menjelskan konsep dan perhitungan algoritma FFT, FIR, Moving average dan Wavelet* - *Dapat menggunakan algoritma untuk pemrosesan biosinyal*	*Smith – Ch. 8, Ch. 12, 14, 15*
6	*Data Filtering and Wave Shaping*	- *Karakteristik Filter* - *Filter Parameter,* - *Noise reduction using Filter* - *Envelope Calculaton* - *Signal Shaping*	- *Dapat menjelaskan karakteristik dan aparameter Filter* - *Dapat merancang digital filter dengan menggunakan MATLAB* - *Dapat mengukur kinerja filter* - *Dapat menerapkan rancangan filter digital untuk noise reduction, envelope calculaton, dan signal shaping*	*Rangayyan Ch. 3* *Smith Ch. 14,* *Semmlow Ch.5*
7	*Spectral Analysis*	- *FFT* - *Spektrum Sinyal*	- *Dapat menjelaskan konsesp analisis spektrumberbasis FFT*	*Semmlow Ch. 3*
8	*Pengukuran Sinyal ECG (1)*	- *Teknik pengambilan data ECG*	- *Dapat melakukan pengambilan data ECG* - *Dapat melakukan perekaman dan penyimpanan data*	*BIOPAC user guide*
9	*Pengukuran Sinyal ECG (2)*	- *Pemrosesan data ECG*	- *Dapat menjelaskan tahapan pemrosesan sinyal ECG* - *Dapat menjelaskan pemrosesan sinyal ECG* - *Dapat melakukan pemrosesan sinyal ECG dengan teknik dasar DSP*	*Rangayyan Ch. 4*
10	*Pengukuran Sinyal ECG(3)*	- *Ekstraksi prameter Sinyal ECG*	- *Dapat melakukan ekstraksi parameter sinyal* - *Dapat mengidentifikasi fitur atau informasi dari sinyal ECG* - *Dapat menginterpretasikan parameter biosinyal terhadap karakteristik fisiologis*	*Rangayyan Ch. 4*
11	*Pengukuran Sinyal EEG (1)*	- *Teknik pengambilan data EEG*	- *Dapat melakukan pengambilan data EEG* - *Dapat melakukan perekaman dan penyimpanan data*	*BIOPAC user guide*
12	*Pengukuran Sinyal EEG(2)*	- *Pemrosesan data EEG*	- *Dapat menjelaskan tahapan pemrosesan sinyal EEG* - *Dapat menjelaskan pemrosesan sinyal EEG* - *Dapat melakukan pemrosesan sinyal EEG dengan teknik dasar DSP*	*Rangayyan Ch. 5, Ch. 6*
13	*Pengukuran Sinyal EEG(3)*	- *Ekstraksi prameter Sinyal*	- *Dapat melakukan ekstraksi parameter sinyal* - *Dapat mengidentifikasi fitur atau informasi dari sinyal EEG* - *Dapat menginterpretasikan parameter biosinyal terhadap karakteristik fisiologis*	*Rangayyan Ch. 5, Ch. 6*
14	*Pengukuran Sinyal EMG (1)*	- *Teknik pengambilan data EMG*	- *Dapat Mmelakukan pengambilan data EMG* - *Dapat melakukan perekaman dan penyimpanan data*	*BIOPAC user guide*
15	*Pengukuran Sinyal EMG (2)*	- *Pemrosesan data EMG*	- *Dapat menjelaskan tahapan pemrosesan sinyal EMG* - *Dapat menjelaskan pemrosesan sinyal EMG* - *Dapat melakukan pemrosesan sinyal EMG dengan teknik dasar DSP*	
16	*Pengukuran Sinyal EMG (3)*	- *Ekstraksi prameter Sinyal*	- *Dapat melakukan ekstraksi parameter sinyal* - *Dapat mengidentifikasi fitur atau informasi dari sinyal EMG* - *Dapat menginterpretasikan parameter biosinyal terhadap karakteristik fisiologis*	

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Program Studi Teknik Elektro
Fakultas Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL4132	**3**	**7**	Teknik Biomedika	Pilihan

Nama Matakuliah	Teknik Biomedika
	Biomedical Engineering
Silabus Ringkas	Pendahuluan. Dasar-dasar Teknik Biomedika. Dasar-dasar Sistem/Instrumentasi Biomedika. Dasar-dasar potensial bio-listrik. Berbagai jenis transducer & sensor biomedika, penguat operasional & penguat biomedika. Masalah keamanan (safety) pasien. Pengenalan anatomi & fisiologi. Topik-topik khusus. Perkembangan baru dalam Teknik Biomedika & Kuliah penutup.
	Introduction. Fundamentals of Biomedical Engineering. Fundamentals of Biomedical System/Instrumentation. Fundamentals of bioelectric. Various biomedical transducer and sensors. Operational amplifier & biomedical amplifier. Patient safety. Introduction to anatomy and physiology.
Silabus Lengkap	Pendahuluan: penjelasan umum matakuliah, tujuan kuliah, topik-topik bahasan, rencana kegiatan, Evaluasi. Dasar-dasar Teknik Biomedika: pengertian Teknik Biomedika, sifat multi-disiplin, prosedur kedokteran (medical procedure), informasi kedokteran (medical information), masalah keamanan (safety), ruang lingkup; pengenalan anatomi & fisiologi, dasar istilah kedokteran. Dasar-dasar Sistem/Instrumentasi Biomedika: diagram blok, bagian-bagian & fungsinya, cara kerja sederhana, contoh-contoh alat bantu diagnosa & terapi sederhana; diagram rangkaian dan perhitungan soal sederhana. Dasar-dasar potensial bio-listrik: prinsip, contoh-contoh, karakteristik dan cara pengukurannya. Berbagai jenis transducer & sensor biomedika, penguat operasional & penguat biomedika. Masalah keamanan (safety) pasien, kejut listrik macroschock & microschock; beberapa alat pengaman dan program keamanan. Pengenalan anatomi & fisiologi, manfaat. Topik-topik khusus: Telemedika, Biomekanika & Teknik Rehabilitasi, Biomaterials & Tissue Engineering, Gelombang Elektromagnetik & ultrasonik. Perkembangan baru dalam Teknik Biomedika & Kuliah penutup: Contoh topik-topik penelitian & tugas akhir; Ringkasan kuliah.
	Introduction: overview, course objective, course topics, schedule, evaluation and assessment. Fundamentals of biomedical engineering: definition, multidisciplinary fields, medical procedure, medical information, safety, scope of biomedical engineering, medical therminology. Fundamentals of biomedical system/instrumentation: block diagram, it's part and their function, principles, examples (diagnose and therapeutic device). Fundamentals of bioelectric: principles, examples, charactheristics and it's measurement. Variuos biomedical transducer and sensors, operational amplifier and biomedical amplifier. Patient safety, electric shock: macroshock and microshock, hospital equipment safety. Introduction to anatomy and physiology. Special topics in biomedical engineering: telemedicine, biomechanics and rehabilitation engineering, biomaterials and tissue engineering. Ultrasonic and electromagnetic in biomedical engineering. Trends in biomedical engineering. Course review.
Luaran (Outcomes)	5. Memahami pengertian ruang lingkup teknik biomedika, 6. Memahami secara teori dan mengimplementasikan subbidang teknik biomedika, 7. Mampu menganalisis masalah di bidang medis & biologi dan merancang solusinya , 8. Mampu mengidentifikasi implementasi terkini di bidang teknik biomedika.
Matakuliah Terkait	EL3013 Sistem Instrumentasi — Prasyarat
Kegiatan Penunjang	*Praktikum, kerja lapangan*
Pustaka	1. Joseph D. Bronzino, The Biomedical Engineering HandBook 2nd Edition, CRC Press LLC, 2000 (*Pustaka utama*)
	2. John G. Webster. Medical Instrumentation: Application and Design, 4th Ed. John Wiley & Sons. 2010 (Pustaka alternatif)
	3. Richard Aston, Principles of Biomedical Instrumentation and Measurement, Merril Publishing Company, 1990 (Pustaka pendukung) 4. Kramme, Rüdiger; Hoffmann, Klaus-Peter; Pozos, Robert Steven. Springer Handbook of Medical Technology. Springer. 2011.
Panduan Penilaian	Praktikum 20%, Tugas 20 %, UTS 30%, UAS 30 %
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pendahuluan	penjelasan umum matakuliah, tujuan kuliah, topik-topik bahasan, rencana kegiatan, Evaluasi	Mahasiswa memahami aturan perkuliahan: jadwal kuliah, ruang lingkup, danskema penilaian	Bab 1 [1], Bab 1 [2], Bab 1 [3]
2	Dasar-dasar Teknik Biomedika.	pengertian Teknik Biomedika, sifat multi-disiplin, prosedur kedokteran (medical procedure), informasi kedokteran (medical information), masalah keamanan (safety), ruang lingkup; pengenalan anatomi & fisiologi, dasar istilah kedokteran	Mahasiswa memahami dasar-dasar, bidang, dan ruang lingkup Teknik Biomedika	Bab 1 [1], Bab 1 [2], Bab 1 [3]
3	Dasar-dasar Sistem/Instrumentasi Biomedika.	pengenalan anatomi & fisiologi, dasar istilah kedokteran. Dasar-dasar Sistem/Instrumentasi Biomedika: diagram blok, bagian-bagian & fungsinya, cara kerja sederhana, contoh-contoh alat bantu diagnosa & terapi sederhana; diagram rangkaian dan perhitungan soal sederhana	Mahasiswa memahami bagian-bagian sistem dan instrumentasi biomedika. Mahasiswa dapat menyebutkan fungsi dan cara kerja instrumentasi biomedika.	Bab 70 – 88 [1]
4	Dasar-dasar potensial bio-listrik.	prinsip, contoh-contoh, karakteristik dan cara pengukurannya	Mahasiswa memahami dasar-dasar dan konsep potensial biolistrik beserta pengukurannya.	Bab 4 – 6 [2], Bab 8 – 17 [1]
5	Berbagai jenis transducer & sensor biomedika	Pengukuran fisis, elektroda, sensor elektrokimia, sensor optik	Mahasiswa memahami konsep pengukuran fisis biolistrik dan biosinyal, elektroda. Mahasiswa dapat menyebutkan dan mengerti macam-macam sensor yang digunakan di teknik biomedika	Bab 47 – 51 [1], Bab 2 [2]
6	Penguat operasional & penguat biomedika.	Ideal Op-Amps, Inverting & noninverting Amplifiers, Integration, Differentiation	Mahasiswa memahami konsep penguatan di instrumentasi biomedika	Bab 3 [2]
7	Masalah keamanan (safety) pasien.	kejut listrik macroschock & microschock; beberapa alat pengaman dan program keamanan	Mahasiswa memahami dan mengerti berbagai macam masalah keamanan devais biomedika beserta cara penangannya.	Bab 13 [2]
8	Pengenalan anatomi & fisiologi.	Manfaat dan hubungannya dengan Teknik Biomedika	Mahasiswa mampu memahami hubungan antara teknik biomedika dengan ilmu anatomi dan fisiologi tubuh manusia.	Bab 1 – 7 [1]
9	Topik-topik khusus: Telemedika	e-health & telemedicine	Mahasiswa mampu memahami dan menerapkan aplikasi teknik biomedika di bidang telemedika	Bab 58 – 67 [4]
10	Topik-topik khusus: Biomekanika & Teknik Rehabilitasi	Gait analysis for rehabilitation	Mahasiswa mampu mengaplikasikan teknik biomedika di bidang biomekanika, khususnya gait analysis for rehabilitation.	Bab 18 – 36 [1]
11	Topik-topik khusus: Biomaterials & Tissue Engineering	Metallic Biomaterials, Ceramic Biomaterials, Polymeric Biomaterials, Composite Biomaterials, Biodegradable Polymeric Biomaterials: An Updated Overview, Biologic Biomaterials, Soft Tissue Replacements, Blood Interfacing Implants, Non-Blood-Interfacing Implants for Soft Tissues, Hard Tissue Replacements, Bone Repair and Joint Implants, Dental Implants: The Relationship of Materials Characteristics to Biologic Properties, Preservation Techniques for Biomaterials, Hip Joint Prosthesis Fixation—Problems and Possible Solutions	Mahasiswa mampu memahami berbagai macam jenis biomaterial beserta sifat-sifatnya. Mahasiswa mengetahui aplikasi biomaterial di bidang teknik biomedika.	Bab 37 – 46 [1]
12	Topik-topik khusus: Gelombang Elektromagnetik & ultrasonik	Ultrasound Transducers, Ultrasonic Imaging, Blood Flow Measurement Using Ultrasound, Electrical Impedance Tomography	Mahasiswa memahami karakteristik ultrasonic dan elektromagnetik beserta aplikasinya di teknik biomedika.	Bab 65 & 67 [1]
13	Perkembangan baru dalam Teknik Biomedika (I)	Tomografi, Medical Imaging	Mahasiswa mengerti dan memahami trend terbaru di teknik biomedika, khusus di bidang tomografi dan pencitraaan medis	Bab 62 – 64 [1]
14	Perkembangan baru dalam Teknik Biomedika (II)	Lab Clinic and Home use medical devais	Mahasiswa mengerti dan memahami trend terbaru di teknik biomedika, Studi kasus: devais medis di lab klinik dan rumah tangga.	Semua referensi dan referensi tambahan dari IEEE (terutama EMBS)
15	Kuliah penutup	Contoh topik-topik penelitian & tugas akhir; Ringkasan kuliah	Review topik-topik kuliah, contoh topik-topik penelitian	Semua referensi

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: ***EL3011***	***Bobot sks:*** **3**	***Semester:*** **5**	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Arsitektur Sistem Komputer			
	Computer System Architecture			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	This course is intended for undergraduate student so that the student will gain a comprehensive knowledge of computer hardware and its interaction with software. The course will also stress on simple MIPS processor design and implementation using VHDL.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	This course will give you an in-depth understanding of the inner-workings of modern digital computer systems and tradeoffs present at the hardware-software interface. You will get an understanding of the design process in the context of a complex hardware system and practical experience with computer-aided design tools. Topics include: Instruction set design, computer arithmetic, controller and datapath design, memory systems, input-output systems, networks interrupts and exceptions, pipelining, performance and cost analysis, computer architecture history, and a survey of advanced architectures			
Luaran (Outcomes)	1. Identify some contributors to computer architecture and organization and relate their achievements to the knowledge area. 2. Explain the reasons and strategies for different architectures. 3. Articulate differences between computer organization and computer architecture. 4. Identify some of the components of a computer. 5. Indicate some strengths and weaknesses inherent in different architectures. 6. Describe how computer engineering uses or benefits from computer architecture and organization.			
Matakuliah Terkait	EL2002 Digital System		Prasyarat	
	EL3111 Prakt. Arsitektur Sistem Komputer		Bersamaan	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Randal E. Bryant, David R., Computer Systems A Programmer's Perpective, 2nd Ed, 2010 [CSAP]			
	John L. Hennessy and David A. Patterson , Computer Organization and Design: The Software Hardware Interface, Morgan Kaufmann Publishers, Fourth Edition, 2009. [P&H]			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction	History of computers Performance Analysis	1. Identify some contributors to computer architecture and organization and relate their achievements to the knowledge area. 2. Explain the reasons and strategies for different architectures. 3. Articulate differences between computer organization and computer architecture. 4. Identify some of the components of a computer. 5. Indicate some strengths and weakness inherent in different architectures. 6. Understand the factors that contribute to computer performance. 7. Understand the limitations of performance metrics. 8. Select the most appropriate performance metric when evaluating a computer.	[P&H] Ch1
2	Integer Operations	Unsigned and Signed Numbers. Range, Arithmetic Operations	1. Appreciate how numerical values are represented in digital computers. 2. Understand the limitations of computer arithmetic and the effects of errors on calculations.	[CSAP] Ch2
3	Floating Point	IEEE754, Representation, Range, Precision, Rounding, and Arithmetic operations	1. Appreciate how numerical values are represented in digital computers. 2. Understand the limitations of computer arithmetic and the effects of errors on calculations.	[CSAP] Ch2
4	Intel's ISA	Data Formats, Accesing Information, ALU Ops, Control	1. Explain the relationship between the representation of machine level operation at the binary level and their representation by a symbolic assembler. 2. Write small programs and fragments of assembly language code to demonstrate an understanding of machine level operations. 3. Implement some fundamental high-level programming constructs at the machine-language level.	[CSAP] Ch3
5	Intel's ISA	Control and Procedure	1. Explain the relationship between the representation of machine level operation at the binary level and their representation by a symbolic assembler. 2. Write small programs and fragments of assembly language code to demonstrate an understanding of machine level operations. 3. Implement some fundamental high-level programming constructs at the machine-language level.	[CSAP] Ch3
	Intel's ISA	Array allocations, Structures, and unions	1. Explain the relationship between the representation of machine level operation at the binary level and	[CSAP] Ch3

			their representation by a symbolic assembler. 2. Write small programs and fragments of assembly language code to demonstrate an understanding of machine level operations. 3. Implement some fundamental high-level programming constructs at the machine-language level.	
6	MIPS's ISA		1. Explain the relationship between the representation of machine level operation at the binary level and their representation by a symbolic assembler. 2. Write small programs and fragments of assembly language code to demonstrate an understanding of machine level operations. 3. Implement some fundamental high-level programming constructs at the machine-language level. 4. Explain why a designer adopted a given different instruction formats, such as the number of addresses per instruction and variable length vs. fixed length formats.	[P&H] Ch2
	ALU	ALU implementations	1. Appreciate how numerical values are represented in digital computers. 2. Understand the limitations of computer arithmetic and the effects of errors on calculations. 3. Appreciate the effect of a processor's arithmetic unit on its overall performance.	[P&H] Ch3
7	MIPS Single Cycle	Datapath and Control	1. Explain the organization of a von Neumann machine and its machine and its major functional units. 2. Explain how a computer fetches from memory and executes an instruction. 3. Articulate the strengths and weakness of the von Neumann architecture. 4. Discuss the impact on control and datapath design for performance enhancements.	[P&H] Ch4
8	Midterm			
9	MIPS Single Cycle	VHDL Implementations	1. Explain the organization of a von Neumann machine and its machine and its major functional units. 2. Explain how a computer fetches from memory and executes an instruction. 3. Articulate the strengths and weakness of the von Neumann architecture. 4. Understand how a CPU chip becomes a complete system.	[P&H] Ch4
	MIPS Pipeline	Datapath modifications	1. Compare alternative implementation of datapaths. 2. Explain basic	[P&H] Ch4

			instruction level parallelism using pipelining and the major hazards that may occur.	
10	MIPS Pipeline	Hazards, forwarding, and control	1. Discuss the generation of control signals using hardwired or microprogrammed implementations. 2. Explain basic instruction level parallelism using pipelining and the major hazards that may occur. 3. Explain what has been done to overcome the effect of branches. 4. Discuss the way in which instruction sets have evolved to improve performance; for example, predicted execution.	[P&H] Ch4
11	Memory Hierarchy	Memory Technology, Cache	1. Identify the main types of memory technology. 2. Explain the effect of memory latency and bandwith on performance. 3. Explain the use of memory hierarchy to reduce the effective memory latency. 4. Describe the principles of memory management.	[P&H] Ch5, [CSAP] Ch6
12	Memory Hierarchy	Virtual memory	1. Explain the use of memory hierarchy to reduce the effective memory latency. 2. Describe the principles of memory management. 3. Design an interface to memory.	[P&H] Ch6, [CSAP] Ch10
13	I/O Subsystem	Peripherals and Storage	1. Explain how to use interrupts to implement I/O control and data transfers. 2. Write small interrupt service routines and I/O drivers using assembly language. 3. Identify various types of buses in a computer system. 4. Describe data access from a magnetic disk drive. 5. Analyze and implement interfaces. 6. Compute the various parameters of performance for standard I/O types. 7. Explain the basic nature human computer interaction devices. 8. Describe data access from magnetic and optical disk drives. 9. Understand how to interface and use peripheral chips. 10. Write sufficient EPROM-based system software to create a basic stand-alone system 11. Specify and design simple computer interfaces.	[P&H] Ch6
14	Introduction to Superscalar	Performance Enhancement,	1. Discuss how	[P&H] Ch7

		ILP, Speculative execution, branch predictions, multithreading, SSE, Altivec	various architectural enhancements affect system performance. 2. Discuss how to apply parallel processing approaches to design scalar and superscalar processors. 3. Discuss how to apply vector-processing techniques to enhance instruction sets for multimedia and signal processing. 4. Understand how each of the functional parts of a computer system affects its overall performance. 5. Estimate the effect on system performance of changes to functional units.	
15	Parallel and Distributed System	Taxonomy, granularity, system examples	1. Explain the differences between different paradigms and their usefulness and applicability. 2. Understand how client server model works in a decentralized fashion. 3. Understand how agents work and how they solve simple tasks. 4. Understand the concept of logical clocks vs. physical clocks and how they affect implementation of distributed systems. 5. Be familiar with simple election and mutual exclusion algorithms and their applicability.	[P&H] Ch7
16	Final Exam			

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Program Studi Teknik Elektro
Sekolah Teknik Elektro & Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL3009	**3**	**5**	**Prodi S1 Teknik Elektro**	Wajib

Nama Matakuliah	Elektronika II
	Electronics II
Silabus Ringkas	Analisis dan desain rangkaian elektronik. Amplifier rangkaian terpadu: blok bangunan, diferensial dan tahap ganda, umpan balik, rangkaian opamp. Filter dan *tuned-amplifier*. Rangkaian untuk pembangkitan sinyal, regulasi tegangan, elemen penyimpanan digital.
	Analysis and design of electronic circuits. Integrated-circuits amplifiers: building blocks, differential and multi stage, feedback, opamp circuits. Filter and tuned amplifiers. Circuits for signal generation, voltage regulation, digital storage elements.
Silabus Lengkap	Mata kuliah ini adalah kuliah lanjutan dalam analisis dan desain rangkaian elektronika. Kuliah ini mencakup penguat diferensial dan multi tahap, penguat umpan balik, blok bangunan dan rangkaian untuk perancangan opamp, filter dan *tuned-amplifier*, pembangkitan sinyal: osilator dan rangkaian pembentuk gelombang, regulasi tegangan: linear dan *switched-mode*, rangkaian untuk elemen sirkuit digital. Setelah mengikuti kuliah ini mahasiswa diharapkan mampu mengidentifikasi, menganalisis, mendiskusikan, dan desain blok pembangun dan rangkaian terintegrasi untuk penguat operasional, mengidentifikasi dan menggunakan rangkaian filter, osilator, regulator dan rangkaian analog pendukung elemen meori digital.
	This course is an intermediate course in electronic circuit analysis and design. It covers differential and multi stage amplifiers, feedback amplifiers,building blocks and circuits for opamp design, filter and tuned amplifiers, signal generation: oscillators and wave shaping circuits, voltage regulation: linear and switch-mode, circuits for digital circuit elements. Finishing this course student will be able to identify, analyze, discuss, and design building blocks and circuits for integrated circuit amplifiers. Identify and apply filters and tuned amplifiers, oscillators, and voltage regulators circuits, and analog circuits for digital circuit elements.
Luaran (Outcomes)	1. Understand the rationale for a differential and multi stage amplifiers, and design one to specifications. 2. List the benefits of negative feedback for amplifier circuits, identify, the type of feedback at work in a given amplifier circuit, and estimate the feedback factor, loop gain, and the allied properties, and Determine, using simulation or by analysis, the phase margin for a given feedback amplifier circuit. 3. Design an RC, LC, or crystal oscillators for a given frequency and for a desired output waveform and design a digital clock generator. 4. Identify, analyse and design filters and tuned-amplifiers. 5. Identify and calculate performance parameters of a voltage regulator, design simple series and shunt regulator, and apply IC voltage regulators. 6. Identify, analyse, and discuss properties of analog circuits for memory elements.
Matakuliah Terkait	EL2005 Elektronika — Prasyarat
	EL3109 Praktikum Elektronika II — Bersamaan
Kegiatan Penunjang	
Pustaka	A. Sedra and K. Smith, Microelectronic Circuits International 6th ed., Oxford University Press, 2011
	Thomas L Floyd, Electronic Devices 9th ed, Prentice Hall, 2011
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Building Blocks of amplifiers (3)	• Gain cell • Cascode amplifier • Bias circuits	• Identify building block of amplifiers • Analyze and discuss their properties • Design building blocks to meet stated specification	Sedra Chp. 6. Sec. 6.1 – 6.6
2	• Differential Amplifiers (3)	• MOS differential pair • Small signal operation of MOS differential pair • BJT Differential pair	• Use large signal and incremental LEC device models to analyze differential pairs. • Explain, compare, and contrast the input, output, and gain characteristics of differential pairs as amplifiers.	Sedra Chp. 7. Sec. 7.1 – 7.3
3	• Differential Amplifiers (3)	• Nonideal characteristics • Differential with active load • High frequency response of differential amplifier	• Use large signal and incremental LEC device models to analyze nonideal characteristics of differential pairs. • Explain, compare, and contrast the input, output, and gain characteristics of differential pairs with active loads. • Produce and analyse the small signal high frequency BJT and MOSFET models differential amplifier circuits.	Sedra Chp. 7. Sec. 7.4 – 7.5 Sedra Chp. 8 Sec. 8.8
4	• Multistage Amplifiers (3)	• Two-stage CMOS opamps • A bipolar opamp • Wide band amplifiera and multistage frequency response	• Explain, compare, and contrast the characteristics of common two-transistor linear amplifier building block stages. • Produce and analyse the small signal high frequency multistage amplifier circuits.	Sedra Chp. 7 Sec. 7.6 Sedra Chp. 8 Sec. 8.9-8.10
5	• Feedback (3)	• Feedback structures and properties of negative feedback. • Feedback topologies: shunt-series, shunt-shut, series-series, series-shunt. • Two-port modelling and the small signal analyses of feedback amplifier.	• Explain the benefits of negative feedback. • Distinguish the feedback circuits and the different feedback configurations in feedback amplifiers. (C2) • Apply the two-port models to include the loading effect of a feedback circuit to the main amplifier. (C3)	Sedra Chp. 9 Sec. 9.1-9.3
6	• Feedback (3)	• Analyses of feedback amplifiers.	• Analyse frequency response of feedback amplifiers. (C4)	Sedra Chp. 9 Sec. 9.4-9.7
7	• Feedback (3)	• Loop gain and amplifier stability. • Stability analyses • Frequency compensation	• Survey the stability of feedback amplifiers. • Design amplifier frequency compensation.	Sedra Chp. 9 Sec. 9.10-9.13
8	• Operational Amplifier circuits (3)	• Two-stage Opamp. • Folded Cascode Amplifiers. • Analyses of 741 Opamp: DC bias	• Point out what components in a circuit affect the low frequency, midband, and high frequency responses, and compute the frequency response for circuits including multiple low and high frequency poles/zeroes. • Analyse CMOS Operational Amplifier. • Subdivide a large analog circuits io its simple building blocks. • Analyse DC bias circuit of 741 opamp.	Sedra Chp. 10 Sec. 10.1-10.4
9	• Operational Amplifier circuits (3)	• Analyses of 741 Opamp: small-signal • Analyses of 741 Opamp: Gain, Frequency Response and Slew rate • Modern BJT opamps	• Produce the small signal equivalent circuits of 741 opamp. • Analyse the performance of 741 opamp. • Describe niches in modern opamp designs.	Sedra Chp. 10 Sec. 10.5-10.7
10	• Filter and Tuned Amplifier	• Filter specification, approximation, and transfer function • Filter topologies and implementations. • Switched-capacitor Filters • Tuned amplifier	• Draw the frequency response curves of a low-pass active filter, a high-pass active filter, a band-pass active filter, and a band-stop (notch) filter • Construct, analyze, and troubleshoot an active low-pass filter, an active high-pass filter, a band-pass filter, or a band-stop (notch) filter. • Identify SC Filter. • Compare the frequency response characteristics of an ideal amplifier and a practical tuned amplifier. (C4) • Perform analyses to calculate the Q and bandwidth of an amplifier. (C4)	Sedra Chp. 11 Sec. 11.1-11.2 Sec. 11.10-11.11
11	• Signal Generators (Oscillators) and Waveform-shaping Circuits	• Principles of sinusoidal oscillators: Barkhausen Criterion and Negative Resistance. • Opamp-RC oscillators • LC, and Crystal	• Describe the function and requirements of an oscillator. (C2) • Describe positive feedback, how it is produced, and how it maintains oscillations after an oscillator is triggered, and list requirements for	Sedra Chp. 12 Sec. 12.1-12.3

		oscillators.	proper oscillator operation. (C2) • Identify, draw the circuits and calculate the parameters for opamp-RC crystal oscillator circuits. (C3)	
12	• Signal Generators (Oscillators) and Waveform-shaping Circuits	• Multivibrators and IC timers • Waveform-shaping circuits.	• Identify, draw the circuits and calculate the parameters for LC , and crystal oscillator circuits. (C3) • Analyze different types of oscillators used in common electronics. (C4) • Analyse and understand the operation of wave shaping circuits. (C4)	Sedra Chp. 12 Sec. 12.4-12.9
13	• Voltage and current regulations	• Shunt and series linear continuous voltage regulator circuits. • Voltage regulator circuits with monolithic integrated circuits.	• List the purpose of a voltage regulator and Explain concept of regulation and methods for regulating voltage and current. (C2) • Calculate performance parameters of a voltage regulator, such as line regulation and load regulation. (C3) • Apply IC linear voltage regulator circuits to design specified output voltage levels. (C3)	Floyd Chp. 17
14	• Voltage and current regulations	• Swicthed-mode regulation: Buck and Boost configurations.	• Describe the circuit operation of a buck/boost switching voltage regulator. (C2) • Apply IC switched regulator sicyuits to design a simple buck/boost switching voltage regulator. (C3)	Floyd Chp. 17
15	• Circuits for digital storage elements (3)	• Latches and Flipflop. Multivibrator circuits. • Semiconductor memory types: RAM, ROM, and Flash. • Memories address: and sensing amplifiers, row decoder, column decoder.	• Describe the structure, configuration, timing parameters and diagrams for memory elements. (C2) • Explain and show the operation of latch circuit and flip-flop circuits and mutivibrators: bistable, monostable, astable. C(3) • Explain the operation and analyses of different types of memories. (C2) • Explain the operation of memory addressing circuits: sensing amplifiers, row decoder, column decoder. (C2)	Sedra Chp. 16 Sec. 16.1-12.4

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL2005	**3**	**4**	**Prodi S1 Teknik Elektro**	Wajib

Nama Matakuliah	Elektronika
	Electronics
Silabus Ringkas	Fisik, operasi, dan model dioda, BJT, MOSFET, dan thyristor. Analisis dan desain penguat satu tahap: bias DC, perilaku sinyal kecil, dan tanggapan frekuensi. Tahap output dan penguat daya. Logika CMOS.
	Physics, operation, and models of diodes, BJT, MOSFET, and thyristors. Analysis and design of single-stage amplifiers: DC bias, small-signal properties, and frequency responses. Output Stage and Power Amplifier. CMOS logics.
Silabus Lengkap	Mata kuliah ini merupakan mata kuliah pertama dalam elektronika. Cakupan materi: Fisik, operasi, dan model dioda, BJT, MOSFET, dan thyristor, Analisis dan desain penguat satu tahap: bias DC, perilaku sinyal kecil, dan tanggapan frekuensi, Klasifikasi tahap output dan penguat daya, pemodelan Thermal dan analisis transistor daya, analisis unjuk kerja inverter CMOS dan perancangan gerbang logika CMOS. Setelah menyelsaikan mata kuliah ini mahasiswa diharapkan dapat menganalisis dan merancang sirkuit sederhana menggunakan dioda, BJT, MOSFET dan, menerapkan thyristor untuk kontrol dayalistrik sederhana, menganalisis tingkat keluaran dari penguat daya dan operasi termal aman, dan desain gerbang logika CMOS AOI.
	This course is the first course in electronics. It covers Physics, operation, and models of diodes, BJT, MOSFET, and thyristors, Analysis and design of single-stage amplifiers: DC bias, small-signal properties, and frequency responses, Classification of amplifier power amplifier output stages, Thermal modelling and analyses of power transistors, Analyses of CMOS inverter performances and design of CMOS and-or-invert logic gates. Finishing this course student will be able to analyse and design simple circuits utilizing diode, BJT, and MOSFET, apply thyristor for simple power controls, analyse output stage of a power amplifier and its thermal save operation, and design CMOS AOI logic gates.
Luaran (Outcomes)	1. Draw the I-V characteristics of a PN junction diode, BJT, MOSFET, and thyristors. 2. Determine the different regions of operation of diode, BJT, and MOSFET. 3. Draw the small-signal model for Diode, BJT and MOSFET. 4. Determine the small-signal parameters of a small-signal model. 5. Design the DC biasing for a single transistor amplifier. 6. Analyze the small-signal properties (input and output impedance, and gain) of a single transistor amplifier. 7. Analyze the frequency response of a single transistor amplifier. 8. Apply thyristor for a simple power control. 9. Analyse output stage of power amplifiers and its thermal properties. 10. Analyse CMOS inverter performance and design of CMOS AOI logic gates.
Matakuliah Terkait	EL2001 Rangkaian Elektrik – Prasyarat
	EL2205 Praktikum Elektronika – Bersamaan
Kegiatan Penunjang	Praktikum Elektronika
Pustaka	A. Sedra and K. Smith, Microelectronic Circuits International 6th ed., Oxford University Press, 2011
	Thomas L Floyd, Electronic Devices 9th ed, Prentice Hall, 2011
Panduan Penilaian	Tugas, Ujian 1, Ujian 2, Ujian Akhir
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• History and overview (1 hr)	• Tube, transistor, and integrated circuits and the information era. • Signal representation and circuit macro modelling.	• Explain how electronics drives the exponential growth in the information era. (C2) • Illustrate the concepts of circuit macro modelling and its application for analysing large and complex circuits. (C2)	Sedra Chp. 1. Sec. 1.1 – 1.6
	• Electronic properties of materials (2 hrs)	• Basic semiconductor concepts. • Semiconductors and device properties.	• Explain and apply the semiconductor concepts of drift, diffusion, donors and acceptors, majority and minority carriers, excess carriers. (C2) • Summarize the main semiconductor properties, energy band, carrier concentration and transport, used for understanding electronic device characteristics. (C2)	Sedra Chp. 1. Sec. 1.7 – 1.12
2	• Diodes (3 hrs)	• Diode structure and IV characteristics • Diode models: large signal models, DC and small signal models	• Explain the underlying physics and principles of operation of p-n junction diodes. (C2) • Produce an incremental (small signal) linear equivalent circuit (LEC) model for a diode knowing its large signal characteristics, and understand and apply standard LEC models for p-n diodes. (C3) • Express the various diode models and their the limitations and choose the appropriate model for a given problem or situation. (C3) • Produce parameter values for large signal and incremental LEC models for p-n diodes based on knowledge of the device structure and dimensions, and of the bias condition. (C3) • Perform a small-signal analysis of diode circuits using small signal models for the diodes. (C4)	Sedra Chp. 3 Sec. 3.1-3.3
3	• Diodes (3 hrs)	• Diode models: reverse breakdown (zener). • Diode applications circuits: rectifying, limiting and clamping, signal switching.	• Perform an analysis of regulator circuits using zener diodes. (C4) • Design simple Diodes circuits to meet stated operating specifications. (C5)	Sedra Chp. 3 Sec. 3.4-3.6
4	• Thyristor (2 hrs)	• PNPN Diode and SCR • DIAC and TRIAC • Application of thyristor	• Explain the operation of PNPN diodes and SCR. • Apply SCR and TRIAC for simple power drive.	Floyd Chp. 11
	• Bipolar transistor (1 hr)	• BJT structure, modes of operation.	• Explain the underlying physics and principles of operation of bipolar junction transistors (BJTs). (C2)	Sedra Chp. 4 Sec. 4.1
5	• Bipolar transistor (3 hrs)	• BJT IV characteristics. • BJT models: large signal and DC models • BJT models small signal models.	• Describes the IV characteristics of BJTs. (C2) • Express the various BJT models and their the limitations, choose the appropriate model for a given problem or situation. (C3) • Produce an incremental (small signal) linear equivalent circuit (LEC) model for a BJTknowing its large signal characteristics, and understand and apply standard LEC models for BJTs. (C3) • Produce parameter values for large signal and incremental LEC models for BJTs based on knowledge of the device structure and dimensions, and of the bias condition. (C3)	Sedra Chp. 4 Sec. 4.2-4.4
6	• Bipolar transistor (3 hrs)	• BJT as an amplifier: General Configurations • Common Emitter (CE) Amplifier • Common Collector (CC) Amplifier • Common Base (CB) Amplifier	• Explain, compare, and contrast the input, output, and gain characteristics of BJT amplifier. (C4) • Perform a small-signal analysis of an amplifier using small signal models for the BJTs. C(4)	Sedra Chp. 4 Sec. 4.5-4.6
7	• Bipolar transistor (2 hr)	• BJT amplifier biasing circuits. • BJT as a switch.	• Design BJT biasing circuit for a single transistor amplifier. (C5) • Design simple BJT amplifier circuits to meet stated operating specifications. (C5) • Perform analyses of BJT as a switch. (C4)	Sedra Chp. 4 Sec. 4.7-4.8
	• MOS transistor (1 hr)	• MOSFET structure, modes of operation	• Explain the underlying physics and principles of operation of MOS field effect transistors (MOSFETs). (C2)	Sedra Chp. 5 Sec. 5.1
8	• MOS transistor (3 hrs)	• MOSFET IV characteristics. • MOSFET models: large signal models	• Describe the IV characteristic of a MOSFET • Express the various MOSFET models and their the limitations and choose the	Sedra Chp. 5 Sec. 5.2-5.4

		• MOSFET circuits at DC • MOSFET models: small signal models.	appropriate model for a given problem or situation. (C3) • Produce an incremental (small signal) linear equivalent circuit (LEC) model for a MOSFET knowing its large signal characteristics, and understand and apply standard LEC models for MOSFETs. (C3) • Produce parameter values for large signal and incremental LEC models for MOSFETs based on knowledge of the device structure and dimensions, and of the bias condition. (C3)	
9	• MOS transistor (3 hrs)	• MOSFET as an amplifier, bias, and biasing circuits. • Basic single MOSFET amplifier configurations • Common Source (CS) Amplifier • Common Drain (SD) Amplifier • Common Gate (CG Amplifier) • MOSFET Biasing Circuits	• Design MOS biasing circuit for a single transistor amplifier. (C5) • Explain, compare, and contrast the input, output, and gain characteristics of single MOSFET amplifier. (C4) • Perform a small-signal analysis of an CD, CS and CG amplifiers using small signal models for the MOS. C(4) • Design simple MOS amplifier circuits to meet stated operating specifications. (C5)	Sedra Chp. 5 Sec. 5.5-5.8
10	• MOS transistor (2 hr)	• MOSFET as a switch.	• Perform analyses of MOSFET as a switch. (C4)	•
	• Frequency Response (1 hrs)	• Amplifier transfer function.	• Sketch the magnitude and phaseof amplifiers transfer function charateristics. (C3)	Sedra Chp. 8 Sec. 8.1
11	• Frequency Response (3 hrs)	• Low frequency respons of amplifier • Common emitter transistor short circuit current gain. Transition frequency. • Hybrid – π model of the bipolar junction transistor. • Miller's theorem and Miller effect inthe voltage gain of common emitter and common source amplifiers.	• Produce and apply the small signal BJT and MOSFET models for low frequency response of simple amplifier circuits. (C3) • Express the high frequency limitations of BJTs and MOSFETs. (C2) • Produce a small signal linear equivalent circuit (LEC, hybrid-π) model for a MOSFET or BJT knowing its juction capacitances and terminal frequency. (C3)	Sedra Chp. 8 Sec. 8.2-8.5
12	• Frequency Response (3 hr)	• Single Transistor Amplifier small signal circuit equivalent for the high frequency	• Produce and apply the small signal high frequency BJT and MOSFET models for CE or CS circuits. (C3) • Produce the small signal high frequency BJT and MOSFET models for the analyses of CC, CD, CB and CG amplifier circuits. (C3)	Sedra Chp. 8 Sec. 8.6-8.7
13	• MOS logic families (1 hr) • Design parameters and issues in CMOS Logics (2 hrs)	• Basic concepts, NMOS and CMOS logic circuits. • Design and analyses of CMOS inverters.	• Explain the operation and features of common MOS logic inverter stages. (C2)Produce the transfer characteristics of a CMOS inverter and show how device dimensions and parameters impact them and inverter switching speed. (C3) • Solve the output produced by a circuit for a given set of inputs using the switch resistor model of a MOSFET. (C3)	Sedra Chp. 14 Sec. 14.1 Sedra Chp. 14 Sec. 14.2-14.3
14	• Design parameters and issues in CMOS Logics (3 hrs)	• Performance analyses of CMOS inverters • CMOS AOI gate structures	• Survey the power dissipation in digital gates and employ CMOS technology to reduce static power losses. (C4) • Design AOI gate circuits.	Sedra Chp. 14 Sec. 14.3-14.4
15	• Output Stage and Power Amplifier (3 hrs)	• Classification of amplifier output stages, output signal waveform, and power disipation. • Biasing the class AB amplifier. • Thermal modelling and thermal management of the transistor power amplifier.	• Explain, compare, and contrast the classes of output stages and power amplifier. (C4) • Determine the operating class (A, AB, B, C) of amplifiers, explain the applications of each type. • Perform load line analysis to predict the voltage swing of transistor circuits and sketch the transfer characteristics. (C4) • Appl y the simplified large signal model to calculate output power, dissipation power and efficiency for emitter (source) follower output stage and class B output stage. (C3) • Perform simple thermal analyses of power transistors. (C4)	Sedra Chp. 13 Sec. 13.1-13.7

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Fakultas Sekolah Teknik Elektro & Informatika

Kode Matakuliah: EL4018	***Bobot sks:*** 2	***Semester:*** 7	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Etika Profesi dan Rekayasa			
	Professional and Engineering Ethics			
Silabus Ringkas	Pendahuluan: penjelasan umum, pokok bahasan, & evaluasi. Kemampuan dasar lulusan perguruan tinggi yang diharapkan masyarakat. Pembahasan maslah etika dalam bekerja. Bahasan khusus: kepribadian, kerjasama, kepemimpinan, manajemen, kewira-usahaan; Biodata, surat lamaran & wawancara. Sejumlah topik khusus & perkembangan baru dalam bidang-bidang keahlian Teknik Elektro terkait.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	• Mahasiswa dapat memahami dan menjelaskan bagaimana engineering dan teknologi dalam implementasi dengan sumber daya yang terbatas merupakan juga kegiatan yang berdampak sosial - politik dengan dampak yang open-ended. • Mahasiswa kemudian dapat mengidentifikasi konteks sosial dan politik dari proses engineering dan teknologi terkini, dilihat dari sisi ekonomi, moneter & bisnis, kegunaan dan manfaat, ergonomi, kesejahteraan, industri, sejarah, keamanan dan keselamatan, lingkungan dll. • Mahasiswa memahami konsep Hak Atas Kekayaan Intelektual (HAKI) dan arti pentingnya dalam kerekayasaan, inovasi dan bisnis. • Mahasiswa dapat memahami berbagai wacana yang berkembang di seputar konsep HAKI, baik dalam tataran individu hingga Negara. • Mahasiswa perlu , khusus teknologi informasi, memahami kebaikan dari proses digitalisasi serta dampak yang terjadi akibat era digital serta teknologi informasi dalam proses rekayasa, kaitannya dengan HAKI maupun dampaknya ke industry dan ekonomi. • Mahasiswa mengetahui dan memahami etika profesi standard yang terkait dan disepakati oleh organisasi profesi IEEE dan ACM.			
Matakuliah Terkait				
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	J.David Irwin: On Becoming An Engineer – A Guide to Career Path, IEEE Press, 1997 (Utama)			
	John Dustin Kemper: Engineers and their Profession, Holt Reinhart & Winston, 1991 (Utama)			
	Gerard Blair: Starting To Manage – The Essential Skills, IEEE Press, 1995			
	Lloyd E. Shefsky: Entrepreneurs Are Made Not Born, McGraw-Hill, 1994			
	M.W. Martin, R. Schinzinger: Ethics in Engineering, McGraw-Hill, 1997			
Panduan Penilaian	Exam 60% Assignments 20% Summary 20%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	EE-SPR01 Social Context of Engineering & Technology		Siswa dapat memahami dan menjelaskan bagaimana engineering dan teknologi dalam implementasinya merupakan juga kegiatan yang berdampak sosial - politik yang open-ended dengan sumber daya terbatas Siswa dapat memberikan contoh-contoh konteks sosial dan politik dari proses engineering dan teknologi terkini, dilihat dari sisi ekonomi, moneter & bisnis, kegunaan dan manfaat, ergonomi, kesejahteraan, industri, sejarah, keamanan dan keselamatan, lingkungan dll.	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	EE-SPR02 Risks and Liabilities of Safety-critical Systems		*Siswa mengetahui dan dapat menjelaskan bagaimana semua proses engineering dan teknologi pasti terkait dengan trade-off antara manfaat, kerugian dan resiko.*	
3			*Siswa mengetahui dan mengidentifikasi persoalan-persoalan engineering yang terjadi dalam berbagai kasus kerekayasaan, khususnya yang terkait dengan keselamatan.*	
4	EE-SPR03 Professional dan Ethical Conduct	*IEEE/ACM Code of Conduct*	*Siswa mengetahui sejarah dari kode etik. Mengetahui apa tujuan dari dibuatnya kode etik dan apa saja isinya.* *Siswa memahami secara detil tentang kode etik yang terkait dengan asosiasi profesional tertentu. Studi kasus: ACM Code of Ethics & Professional Conduct & IEEE Code of Ethics*	
5		*Plagiarism*	*Siswa memahami secara detil tentang plagiarism*	
6	*EE-SPR04 Intellectual Property*		*Siswa mengetahui sejarah dari berbagai macam HAKI. Mengetahui apa tujuan dari dibuatnya HAKI dan apa efeknya keberadaan HAKI dalam berbagai aspek kehidupan baik pada level mikro maupun makro dan global.*	
7			*Siswa memahami secara mendalam perbedaan antara berbagai jenis HAKI dan mampu mengidentifikasi potensi HAKI dari berbagai kegiatan dan temuan.*	
8			*Siswa memahami secara detil tentang pelanggaran HAKI.*	
9	*EE-SPR05 Digital Revolution*		*Siswa memahami apa arti revolusi komputer dan revolusi digital serta dampaknya terhadap berbagai kegiatan manusia di berbagai bidang: perbankan, keamanan, transportasi, kreativitas dll.*	
10			*Siswa dapat mengidentifikasi resiko dan ancaman dalam konteks dari terjadinya revolusi komputer, revolusi digital dan internet.*	
11			*Siswa memahami secara detil dampak revolusi komputer, digital dan internet terhadap privasi dan kebebasan sipil.*	
12			*Siswa memahami urgensi regulasi dan etika serta dapat melihat dan memahami dilema kemajuan vs. keselamatan & keamanan.*	
13	*EE-SPR06 Keamanan Informasi*		*Siswa memahami apa arti dan nilai dari informasi dan apa yang disebut keamanan informasi .*	
14			*Siswa dapat mengidentifikasi potensi-potensi ancaman terhadap keamanan informasi dan dampaknya dalam berbagai kegiatan sehari-hari.*	
15			*Siswa mengetahui dan dapat merancang berbagai cara untuk dapat mengatasi ancaman-ancaman tersebut (personal & organizational level)*	

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4092	***Bobot sks:*** 2	***Semester:*** 8	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Kerja Praktek			
	Industrial Experiences			
Silabus Ringkas	Kerja praktek yang dilakukan oleh mahasiswa dilingkungan kerja, baik industri, lembaga riset, dll untuk memberikan gambaran kepada mahasiswa tentang lingkungan kerja yang akan dihadapinya, disamping juga untuk memberikan pengalaman kerja dan memperluas wawasannya. Mahasiswa yang diperbolehkan mengambil Kerja Praktek adalah mahasiswa yang telah memperoleh kuliah hingga semester 6. Kerja praktek dilaksanakan selama minimal 2 bulan dan maksimal hanya 1 bulan boleh dilksanakan di lembaga riset atau laboratorium/universitas.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	This course is intended so that students can have industrial experience.			
Matakuliah Terkait	Completed at least 104 credits		Prasyarat	
	Lihat Catatan Tambahan		Prasyarat	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Written report 80% Seminar 20%			
Catatan Tambahan	Mahasiswa yang diperbolehkan mengambil Kerja Praktek adalah mahasiswa yang telah mengikuti kuliah hingga semester 6			

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	[*Cantumkan Topik bahasan*]	[*Uraikan sub-topik bahasan*]	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
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KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3012	***Bobot sks:*** **3**	***Semester:*** **5**	***KK/ Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Material Teknik Elektro			
	Electrical Engineering Material			
Silabus Ringkas	Introduksi : klasifikasi material : conductor, semiconductor and insulator ; Struktur Material : Kristal, polikristal dan amorph; Struktur kristal dan parameters : konstanta kisi2, sel satuan, 14 sistem Bravais,indeks Miller (kisi2 resiprokal). Vibrasi Kisi2 : mekanika gelombang; Emisi Phonon : phonon akustik, phonon optik; Ikatan Kristal : enerji kohesif dan tipe ikatan Kristal ; Model Ban Enerji : Potensial periodic kisi2 kristal; Model Kronnig-Penney, Model Ban Enerji ; Konsep electron (konduksi) dan hole Statistika partikel : Statistika Fermi Dirac, Fermi Dirac function Density of states (DOS), konsentrasi pembawa muatan : elektron dan hole, level enerji Fermi level (eF); Scattering pembawa muatan : scattering-kisi2 (Lattice Scattering), Scattering Ketidakmurnian (ionized impurity/Coulombic scattering), scattering rate, mobilitas electron (hole) (m); Relasi mobilitas terhadap temperatur, medan listrik dan kecepatan saturasi; Arus Drift ; Proses Difusi : Arus difusi ; Persamaan Kontinyuitas : mekanisme R(ekombinasi) – G(enerasi) pembawa muatan; Mekanisme fisika Dioda P-N Junction : proses difusi antar junction, ruang-muatan (daerah deplesi) dan barier potensial 'built-up'. Penurunan karakteristik arus-tegangan Dioda P-N (Karakteristik I-V) : relasi terhadap to beda potential (catu daya 'forward' and 'reverse' bias), komponen arus dioda			
	Introduction: classification : conductor, semiconductor and insulator. Structure of Material ; Crystal Structure, parameters : Lattice constant, Unit cell, Bravais system, Miller index (reciprocal lattice). Lattice vibration : Phonon emission : acoustical and optical phonon Crystal Bonding : cohesive energy, : type of crystal bonding Energy Band Model: Periodic potentials of crystal lattice : Kronnig-Penney model, (simplified) Energy Band Model; Concept of Electron and Hole. Particle Statistics in material : Carrier Statistics (electron (and hole) in material (semiconductor) : Fermi Dirac Statistics, Fermi Dirac function Density of States (DOS), Carrier (electrons and holes) concentration, Fermi level (eF) ; Carrier Scattering phenomenon : Lattice and ionized impurity scattering ; Mobility (μ), scattering rate, effective mass ; Mobility relation to temperature, electric field and saturation velocity; Drift current ; Carrier Diffusion Process ; Diffusion Current density ; Continuity equation, carrier Recombination – Generation process mechanism; Physics of P-N Junction Diode : junction diffusion process, space-charge (depletion region) and potential barrier built-up. Origin of Diode current-voltage (I-V) Characteristics : relation to applied potential (forward and reverse bias) ; Diode current components.			
Silabus Lengkap	Introduksi : aplikasi material relasi di teknik elektro sesuai dengan sifat material; Classification based on σ (conductivity) : conductor, semiconductor and insulator. Abstraksi 'microscopic view' electron dalam 'lautan' enerji potensial kisi-kisi material ; Klasifikasi material (berdasarkan, σ, konduktivitas) : konduktor, semikonduktor and insulator ; Struktur Material : Kristal, polikristal dan amorph; Struktur kristal dan parameters : konstanta kisi2, sel satuan, 14 sistem Bravais, indeks Miller (kisi2 resiprokal), 'atomic packing fraction' (APF), kerapatan permukaan. Model pegas Vibrasi Kisi2 : Emisi Phonon : phonon akustik, phonon optik; penurunan persamaan gelombang (vibrasi) : 1-D Monatomic and Diatomic ; mode vibrasi longitudinal and transversal phonon akustik dan optik : Ikatan Kristal : enerji kohesif dan tipe ikatan Kristal : ikatan Van der Waals, ikatan ionik, ikatan kovalen, ikatan metalik dan ikatan Hidrogen. Model Ban Enerji : Potensial periodik kisi2 kristal; Model Kronnig-Penney, Model Ban Enerji (disederhanakan) : gap enerji (εg), Ban Konduksi (εC), Ban Valensi (εV), level enerji intrinsic (εi) ; Konsep elektron (konduksi) dan hole. Statistika partikel di material : statistika klasik Boltzmann statistics; statistika kwantum: Statistik Bose-Einstein,Statistik Fermi Dirac(FD), Fungsi Fermi Dirac Density of states (DOS), konsentrasi pembawa muatan : elektron dan hole, level enerji Fermi level (eF) di model Ban Enerji ; 'Scattering' pembawa muatan : scattering-kisi2 (Lattice Scattering), Scattering Ketidakmurnian (ionized impurity), hokum Matthiessens' ; Mobilitas elektron (hole) dalam konduktivitas material (Semikonduktor), scattering rate/waktu relaksasi, massa efektip; Relasi mobilitas terhadap temperature dan medan listrik, kecepatan saturasi; Arus Drift ; Proses Difusi : gradien konsentrasi, relasi Einstein, Arus difusi ; Total arus Drift dan Difusi. Persamaan Kontinyuitas: mekanisme R(ekombinasi)–G(enerasi) pembawa muatan ;			

	Mekanisme fisika Dioda P-N Junction : proses difusi antar junction, ruang-muatan (daerah deplesi) dan barier potensial 'built-up'. Penurunan karakteristik arus-tegangan Dioda P-N (Karakteristik I-V) : relasi terhadap to tegangan catu daya 'forward' and 'reverse', komponen arus Dioda. Introduction : application of material related to their properties in electrical engineering; Classification based on σ (conductivity) : conductor, semiconductor and insulator. Initial 'microscopic' view of electrons travelling bounced by potential energy of material lattice . Structure of Material ; Crystal Structure, parameters : Lattice constant, Unit cell : 14 Bravais system, Miller index (reciprocal lattice): crystal orientation, symmetry, plane distance, angle of crystal plane intersection; APF (atomic packing fraction), surface density Lattice Vibration : collision with electron ; Phonon emission : acoustical and optical phonon,derivation (vibration) wave mechanics 1-D Monatomic and Diatomic longitudinal and transversal vibration wave: Crystal Bonding : cohesive energy, type of bonding : Van der Waals, Ionic bonding, Covalent bonding, Metalic bonding and Hydrogen bond Energy Band Model : Periodic potentials of crystal lattice : Kronnig-Penney model, (simplified) Energy Band Model : energyi gap (εg), Ban Konduksi (εC), Ban Valensi (εV), level enerji Intrinsic (εi); Concept of (conducting) Electron and Hole. Particle Statistics in material : classical Boltzmann statistics; Quantum Statistics : Bose-Einstein, Fermi Dirac (FD) Statistics, FD Function Density of States (DOS), Carrier (electrons and holes) concentration, Fermi level (eF) in energy band model ; Carrier Scattering : Lattice and ionized impurity scattering; Mobility (μ) as conductivity property of material, scattering rate (relaxation time), effective mass; Mobility relation to temperature and electric field, Saturation velocity ; Drift current ; Carrier Diffusion Process : concentration gradient; relasi Einstein; Diffusion Current density ;Total current of Drift and Diffusion Continuity equation, carrier Recombination – Generation process; Physics of P-N Junction Diode : junction diffusion process, space-charge (depletion region) and potential barrier built-up. Origin of Diode current-voltage (I-V) Characteristics : relation to applied potential (forward and reverse bias) ; Diode current components.
Luaran (Outcomes)	Student acquires first view of application of material(s) related to their properties in device, PCB, module and system of electrical engineering; Student understands origin of the (conductivity) as properties of the material which governs current in relation to apllied voltage (electric field) known as R(esistance). Students are recalled to class of material related to conducting behavior (conductivity) : conductor, insulator (dielectric) and semiconductor. Student will have initial 'microscopic' view of electrons travelling 'sea of wave of potential energy of atomic lattice of material, which is material element as unique. Student understands structure of material : crystal, poly-crystal and amorph ; Student understands crystal structure in direct lattice and parameters : bases, lattice constant and unit cell. Students will be knowledgeable of Bravais systems of 14 basic structures. Students becomes knowledgeable in indirect (reciprocal) lattice and understand use of index Miller to derive crystal plane orientation, direction and symmetry. Students understand packing fraction and surface densityof various crystal especially of Cubic and hexagonal closed pack system. Understands mechanical-physics lattice (atoms in crystal) vibrating as spring-like - mechanical wave of atoms; Know the origin of lattice vibration: energy and momentum exhange of collision with (conducting) electrons. Comprehend derivation of lattice wave equation and mechanism of absorption and emission of phonon (heat in material) in either one : acoustical or optical phonon mode. Know how to derive simple 1-D monatomic and diatomic crystal - lattice wave and find solution : lattice vibrating wave as function of k (wave vector); Understand the lattice wave relation to longitudinal and transversal vibration of atoms. Understands nature of physics of Crystal Bonding : cohesive energy in lattice as combination of attractive and repulsive forces of atom nucleus and valence electrons. Becomes knowledgeable of type of material crystal bonding : Van der Waals, metalic, covalent, ionic and Hydrogen bonding and material properties. Comprehends energy potential (band) of material element and alloy; (2) Knowledgeable existence of periodic potential energy (Kronnig-Penney model) and origin (simplified) Energy Band Model of material ; (3) Acquiring the practical knowledge of the Energy Band Model and the reference (potential) energy levels of the model, from the basic knowledge of the properties of electrical (conductivity and dielectric) of materials as conductor, insulators & semiconductor conductors to concept of electron and hole with potential (energy) levels and their potential gradient in Energy Band Model, as well as introduction the use in the structure of electronic (semiconductor) devices. Students will have introductory knowledge of class and application of statistics in determining particles and other constituents in material and solid state universe such as electron/hole, phonon, photon and other states. Students will be acquainted derivation of Fermi Dirac statistics using Langrangian multiplier. Students will have scientifical-engineering view on 'learning - exponential curve' of governing I-V characteristics of diode and other other junction devices which is explained by statistics of carrier population. Student posseses practical knowledge of Boltzmann and Fermi-Dirac statistics as probability in finding charge/carrier (electron and hole) in material (semiconductor). Students understand essence of Density of states (DOS) as (potential energy) level clusters for carrier to occupy : electrons in Conduction band and holes in Valence band, respectively. Students will know origin (derivation) DOS equation and its relation to energy (potential) in conduction and valence band of semiconductor material. Students know to derive electron (n) and hole concentration (p) equations thru integration of Fermi Dirac probability ((as fuction of Fermi level = doping level) and density of

	states as function of energy (of the carrier) in respective band (conduction and valence bands). Students becomes familiar in calculating carrier concentration (electron, n and hole, p) and plot Fermi level (EF) in Energy Band Model. Students understand the scattering process of electron collision in lattice of material : (1) Coulombic scattering (ionized impurity), Acoustical and Optical Phonon scattering . Student can (2) describe mobility (μ) related to scattering rate (τ) and effective mass of electron (or hole, m*); Student can (3) figure out combined effect of all scattering mechanisms using Matthiessen's rule and qualitatively explains dominant effect of either lattice or impurity scattering according to temperature. (4) Understand drift current as result of existence of electric field (E) and mobility - where electron drift due to electric field overcoming random motion of thermal drift. Qualitatively able to describe (5) drift speed as function electric field (E) and saturation velocity (vsat) above the critical field (ECR) as result of optical phonon scattering. Student understands diffusion transport of carrier (electron,hole) in semiconductor due to gradient concentration. Student is able to derive diffusion current from the gradient concentration and understands Einstein relationship of diffusion coeffient to electron (hole) mobility. Student will have comprehensive knowledge on total current in semiconductor due to Drift and Diffusion of electron and hole. Student understands essence of Continuity equation which leads to carrier conservation in semiconductor. Student becomes knowledgeable in carrier Generation - electron-hole pair generation as result of thermal excitation or other form energy excitation mechanism such as photo-excitation (due to photon-illumination), pressure (piezoelectric) and others. Student understand physic mechanism of carrier Recombination - direct and indirect thru intermediate states in forbidden gap (SRH : Schockley-Read-Hall recombination and surface recombination), especially in the origin of P-N junction recombination current. Students are able to (1) explain the physical mechanism of P-N Junction : diffusion of electron and hole accross P-N sides of the junction, space charge and potential barrier built-up in depletion region. Students are able to derive (2) current-voltage (I-V) characteristics of PN Junction Diode. Students can (3) explain physics of carriers crossing junction barrier when the applied bias in forward and reverse condition : depletion region width and junction barrier increase. Students can sort out the P-N Junction diode current components and differentiate each origin from diode I-V characteristics.	
Matakuliah Terkait	KI1202 Kimia IIB	Prasyarat
	EL2006 Medan Eelktromagnetik	Prasyarat
Kegiatan Penunjang	-	
Pustaka	1:B.G Streetman, S. Banerjee, "Solid State Electronic Devices", Prentice Hall	
	2: C. Kittel, "Introduction to Solid State Physics", John Wiley & Sons	
	3: Handout Module Bab I sd Bab XI , Dosen Pengajar ((Basuki R. Alam)	
Panduan Penilaian	Tugas (20%) , UTS (35 %) , UAS (45%)	
Catatan Tambahan	-	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	**Introduction**	• ***Introduction*** : application of material related to their properties in electrical engineering; • Classification based on σ (conductivity) : conductor, semiconductor and insulator. • Initial 'microscopic' view of electrons in sea of potential energy of lattice .	• *Understand application of material(s) related to their properties in main/supporting components,devices, circuits (PCB), modules, equipments and systems of electrical engineering;* • *Student understands the origin of the **s** (conductivity) as properties of the material which determine current in relation to apllied voltage (electric field) known as resistance.* • *Students become knowledgeable to class of material related to conducting behavior (conductivity) : **conductor**, **insulator** (dielectric, **semiconductor**.* • *Student will have initial 'microscopic' view of electrons travelling affected by potential energy of atomic lattice of material as unique.*	• **Reference # :** • 1 • 3
2	**Material Structure**	• Crystal Structure, parameters : Lattice constant, Unit cell : 14 Bravais system, • Miller index (reciprocal lattice): crystal orientation, symmetry, plane distance, angle of crystal plane intersection; • APF (Atomic packing fraction), surface density	• *Student understands structure of material : crystal, poly-crystal and amorph ;* • *Student understands crystal structure in direct lattice and parameters : bases, lattice constant and unit cell. Students will be knowledgeable of Bravais systems of 14 basic structures.* • *Students becomes knowledgeable in indirect (reciprocal) lattice and understand use of index Miller to derive crystal plane orientation, direction and symmetry.* • *Students understand packing fraction and surface densityof various crystal especially of Cubic and hexagonal closed pack system.*	• **Reference # :** 1 2 3
3	***Lattice Vibration***	• ***Lattice Vibration*** : collision with electron; Phonon emission : Acoustical and Optical phonon, • (vibration) wave mechanics 1-D Monatomic and Diatomic • Longitudinal and transversal vibration wave:	• *Understands mechanical-physics lattice (atoms in crystal) vibrating as spring-like - mechanical wave of atoms;* • *Know the origin of lattice vibration: energy and momentum exhange of collision with (conducting) electrons.* • *Comprehend derivation of lattice wave equation and mechanism of absorption and emission of phonon (heat in material) in either one : acoustical or optical mode.* • *Know how to derive simple 1-D monatomic and diatomic crystal - lattice wave and find solution : lattice vibrating wave as function of k* • *Understand the lattice wave relation to longitudinal and transversal vibration of atoms.*	• **Reference # :** • 2 • 3
4	***Crystal Bonding***	• ***Crystal Bonding*** *: cohesive energy,* • *Type of bonding : Van der Waals, Ionic bonding, Covalent bonding, Metalic bonding, Hydrogen bond*	• *Understands nature of physics of Crystal Bonding : cohesive energy in lattice as combination of attractive and repulsive forces of atom nucleus and valence electrons.* • *Becomes knowledgeable of type of material crystal bonding : Van der Waals, metalic, covalent, ionic and Hydrogen bonding and material properties.*	• **Reference # :** • 2 • 3
5	***Energy Band Model***	• Periodic potentials of crystal lattice : Kronnig-Penney model, • (Simplified Potential) Energy Band Model *:* energyi gap (ε_g), Ban Konduksi (ε_C), Ban Valensi (ε_V), level enerji Intrinsic (ε_i); • Concept of (conducting) Electron and Hole.	• *Comprehends energy potential (band) of material element and alloy;* • *Knowledgeable existence of periodic potential energy (Kronnig-Penney model)* • *Know origin (simplified) Energy Band Model* • *Acquiring practical knowledge of the Energy Band Model and the reference (potential) energy levels of the model, from the basic knowledge of the properties of electrical (conductivity and dielectric) of materials as conductor, insulators & semiconductor conductors to concept of electron and hole with potential (energy) levels and their potential gradient in Energy Band Model,* • *Acquire introduction usage of energy band model of structure of semiconductor devices.*	• **Reference # :** • 1 • 2 • 3

6	***Particle Statistics***	• ***Particle Statistics*** in material (classification) : classical Boltzmann statistics; Quantum Statistics : Bose-Einstein, • Fermi Dirac (FD) Statistics : derivation, Langrangian multiplier • Fermic Dirac Function	• *Students will have introductory knowledge of class and application of statistics in determining particles and other constituents in material and solid state universe such as electron/hole, phonon, photon and others.* • *Students will be acquainted derivation of Fermi Dirac statistics using Langrangian multiplier.* • *Students will have scientifical-engineering view on 'learning - exponential curve' of governing I-V characteristics of diode and other other junction devices which is explained by statistics of carrier population.* • *Student posseses practical knowledge of Boltzmann and Fermi-Dirac statistics as probability in finding charge/carrier (electron and hole) in material (semiconductor).*	• **Reference # :** • 3
7	***Density of States* (DOS),**	• ***Density of States*** (DOS) • Carrier (electrons and holes) concentration, • Fermi level (e_F) in energy band model ;	• *Students understand essence of Density of states (DOS) as (potential energy) level clusters for carrier to occupy : electrons in Conduction band and holes in Valence band, respectively.* • *Students will know origin (derivation) DOS equation and its relation to energy (potential) in conduction and valence band of semiconductor material.* • *Students know to derive electron (n) and hole concentration (p) equations thru integration of Fermi Dirac probability ((as fuction of Fermi level = doping level) and density of states as function of energy (of the carrier) in respective band (conduction and valence bands).* • *Students becomes familiar in calculating carrier concentration (electron, n and hole, p) and plot Fermi level (E_F) in Energy Band Model.*	• **Reference # :** • 1 • 2 • 3
8	***Carrier Scattering***	• ***Carrier Scattering*** : Lattice and ionized impurity scattering; • ***Matthiessen's rule*** : dominant scattering (related to T) • Mobility (μ) : conductivity of material, scattering rate, effective mass; • Mobility relation to temperature (T) • Mobility relation to electric field (E) • Saturation velocity (v_{sat}) ; • Drift current ;	• *Students understand the scattering process of electron collision in lattice of material : (1) Coulombic scattering (ionized impurity), Acoustical and Optical Phonon scattering* • *Student can describe mobility (μ) related to scattering rate (τ) and effective mass of electron (or hole, m^*);* • *Student can figure out combined effect of all scattering mechanisms using Matthiessen's rule and qualitatively explains dominant effect of either lattice or impurity scattering according to temperature.* • *Understand drift current as result of existence of electric field (E) and mobility - where electron drift due to electric field overcoming random motion of thermal drift.* • *Qualitatively able to describe (5) drift speed as function electric field (E) and saturation velocity (v_{sat}) above the critical field (E_{CR}) as result of optical phonon scattering.*	• **Reference # :** • 1 • 3
9	***Carrier Diffusion Process***	• ***Carrier Diffusion Process*** : concentration gradient; relasi Einstein; Diffusion Current density;Total current of Drift and Diffusion	• *Student understands diffusion transport of carrier (electron,hole) in semiconductor due to gradient concentration.* • *Student is able to derive diffusion current from the gradient concentration and* • *understands Einstein relationship of diffusion coeffient to electron (hole) mobility.* • *Student will have comprehensive knowledge on total current in semiconductor due to Drift and Diffusion of electron and hole.*	• **Reference # :** • 1 • 3
10	***Continuity equation*,**	• ***Continuity equation***, • Generation process : • Recombination : SRH Recombination, Surface Recombination	• *Student understands essence of Continuity equation which leads to carrier conservation in semiconductor.* • *Student becomes knowledgeable in carrier Generation - electron-hole pair generation as result of thermal excitation or other form energy excitation mechanism such as photo-excitation (due to photon-illumination), pressure (piezoelectric) and others.*	• **Reference # :** • 1 • 3

			• *Student understand physic mechanism of carrier Recombination - direct and indirect thru intermediate states in forbidden gap (SRH : Schockley-Read-Hall recombination and surface recombination), especially in the origin of P-N junction recombination current.*	
11	***P-N Junction Diode***	• Physics of ***P-N Junction*** : junction diffusion process, space-charge (depletion region), potential barrier built-up. • Origin of Diode current-voltage(I-V) Characteristics : • relation to applied potential (forward and reverse bias) ; • Diode current components	• *Students are able to explain the physical mechanism of P-N Junction : diffusion of electron and hole accross P-N sides of the junction, space charge and potential barrier built-up in depletion region.* • *Students are able to derive current-voltage (I-V) characteristics of PN Junction Diode.* • *Students can explain physics of carriers crossing junction barrier when the applied bias in forward and reverse condition : depletion region width and junction barrier increase.* • *Students can sort out the P-N Junction diode current components and differentiate each origin from diode I-V characteristics.*	• **Reference # :** • 1 • 3
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KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2006	***Bobot sks:*** 3	***Semester:*** 4	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Medan Elektromagnetik			
	Electromagnetics			
Silabus Ringkas				
	History and Overview; Vector Analysis; Coulomb's Law, Electric Field Intensity; Electric Flux Density, Gauss's Law, Divergence; Energy, Potential, Gradient; Conductors, Dielectrics, Capacitance; Poisson's and Lapace's Equations; The steady magnetic field, curl; Magnetic Forces, materials, inductance; Time Varying Fields, Maxwell's Equations; Uniform Plane Wave, Plane Waves at boundaries and in dispersive media; Transmission lines; Waveguide and antenna fundamentals; Huygens-Freshnel Principle, spatial frequency, angular spectrum			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	Students learn topics rannging from Coulomb's Law to Huygens-Freshnel Principle, i.e. History and Overview; Vector Analysis; Coulomb's Law, Electric Field Intensity; Electric Flux Density, Gauss's Law, Divergence; Energy, Potential, Gradient; Conductors, Dielectrics, Capacitance; Poisson's and Lapace's Equations; The steady magnetic field, curl; Magnetic Forces, materials, inductance; Time Varying Fields, Maxwell's Equations; Uniform Plane Wave, Plane Waves at boundaries and in dispersive media; Transmission lines; Waveguide and antenna fundamentals; Huygens-Freshnel Principle, spatial frequency, angular spectrum			
Luaran (Outcomes)	Understand electrostatics and electrodynamics phenomena Understand and apply Coulomb's Law, Gauss's Law, Poisson's and Lapace's Equations Understand magnetostatics and magnetodynamics phenomena Understand and apply Maxwell's Equations to palne wave in transmission line Understand wave guide and antenna fundamentals Understand Huygens-Freshnel Principle, spatial frequency, angular spectrum			
Matakuliah Terkait	FI1201 Fisika IIA		Prasyarat	
	MA2072 Matematika Teknik I		Prasyarat	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Willam H. Hayt, Jr., John A. Buck, Engineering Electromagnetics, 8th Edition, McGraw Hill, 2012			
	Fawwaz T. Ulaby, Fundamentals of Applied Electromagnetics, 6th Edition, Prentice Hall, 2010			
	G.B. Arfken and H.J. Weber: Mathematical Methods for Physicists; 4th edition, Academic Press,			
	Jerrold Franklin, Classical Electromagnetism, Addison Wesley, 2005			
	Joseph W. Goodman, Introduction to Fourier Optics, McGraw-Hill, 1996			
Panduan Penilaian	UTS 40%, UAS 40%, Assignments 20%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	History and Overview; Vector Analysis	History of electromagnetics, overview of electromagnetics, vector algebra, coordinate systems, line integral, surface integral, volume integral	• Identify some contributors to electromagnetic-optics and relate their achievements to the knowledge area. • Appreciate the importance of electromagnetics from a historical perspective. • Explain why electromagnetic-optics is important to this subject. • Articulate why charge distributions and current density are the fundamental elements of an electromagnetic-optics systems. • Describe how electrical engineering uses or benefits from electromagnetics-optics • Demonstrate skill in solving problems of vector algebra and integral vector and presenting problem solutions • Interpret the physical meaning and phenomena behind mathematical equations and computed results. • Be able to apply mathematical techniques to formulate the fundamental field equations and to analyse electromagnetic phenomena related to electrical engineering systems.	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Coulomb's Law, Electric Field Intensity	Charge distributions, Coulomb's law, electric field intensity	• Compare and contrast the inverse square nature of gravitational and electric fields • State Coulomb's Law and solve problems for more than one electric force acting on a charge. Include: one and two dimensions • Apply Gauss's and Coulomb's laws	
3	Electric Flux Density, Gauss's Law, Divergence	Gauss's law and applications, divergence and Maxwell's first equation, divergence theorem	• Interpret the physical meaning and phenomena behind mathematical equations and computed results. • Calculate simple geometry of charge distributions to derive their electric fields by using divergence and divergence theorem.	
4	Energy, Potential, Gradient	Energy and potential difference, potential gradient, energy density in the electrostic field	• Derive an equation for the electric potential energy between two oppositely charged parallel plates (Ee = qEΔd). • Define and calculate the gradient of electric potentials.	
5	Conductors, Dielectrics, Capacitance	Current density, conductance and resistance of metallic conductors, polarization of dielectric materials, capacitance	• Distinguish between materials, based on their electromagnetic properties • Apply Maxwell's equations in dielectric materials using vector D, E, and P fields • Design resistors and analyse their characteristics • Design capacitors and analyse their characteristics	
6	Poisson's and Lapace's Equations	Poisson's and Laplace's equations in various coordinate systems	• solve simple boundary value problems, using the method of images and Poisson's equation.	
7	The steady magnetic field, curl	Biot-Savart and Ampre's law, curl and Stoke's theorem, magnetic flux and magnetic flux density, scalar and vector magnetic potentials	• Define the magnetic field as the region of space around a magnet where another magnet will experience a force. • Diagram and describe qualitatively the magnetic field around a current carrying wire. • Describe the concept of magnetic poles and demonstrate that like poles repel and unlike poles attract. • Diagram and describe qualitatively the magnetic field of a solenoid.	
8	Magnetic Forces, materials, inductance	Lorentz's Law, the nature of magnetic materials, magnetization and permeability, magnetic boundary conditions, magnetic circuits, self and mutual inductance	• Apply Maxwell's equations in magnetic materials using vector B, H, and M fields • Design inductors and analyse their characteristics • Describe the concepts of magnetic material characteristics • Solve magnetic circuit problems	
9	Time Varying Fields,	Faraday's law, displacement	• Formulate and solve problems in	

	Maxwell's Equations	current, Maxwell's equations, retarded potentials	electrodynamics using Faraday's and Ampere's laws. • Demonstrate how a change in magnetic flux induces voltage. • Use Gauss', Ampere's and Faraday's Laws in the context of electrical devices. • Describe the operation of an AC generator. • Describe the operation of transformers.	
10	Uniform Plane Wave	Wave propagation in free space, in dielectric, in conductor, wave polarization, Poynting's theorem and wave power	• Describe a wave as a transfer of energy. • Describe the engineering uses of electromagnetic waves, by frequency band, and the respective hazards associated with them • Calculate wave power from electric-magnetic field distributions	
11	The Plane Waves at boundaries and in dispersive media	Reflection and refraction, standing wave ratio, wave propagation in dispersive media	• Describe, demonstrate, and diagram the transmission and reflection of electromagnetic waves. • Recognize and describe dispersion and its effects	
12	Transmission Lines	Transmission line equations, voltage standing wave ratio, transmission lines of finite length, the Smith chart	• Define core loss in an electromagnetic device, and recognise & describe its effect • Use and interpret a Smith chart	
13	Waveguide and antenna fundamentals	Basic waveguide operation, metalic waveguide, optical fiber, basic radiation principles,	• Describe & recognise fundamental properties of waveguide modes	
14	Waveguide and antenna fundamentals	Antenna specitication, wire antenna, arrays antenna, aperture antenna	• Use dipole antennas in simple communication links	
15	Huygens-Freshnel Principle, spatial frequency, angular spectrum	Kirchoff formulation of diffraction by a planar screen, Rayleigh-Sommerfeld formulation of diffraction, Huygens-Freshnel principle, spatial frequency, angular spectrum and its physical interpretation, propagation of angular spectrum	• Describe light as an electromagnetic wave. • Huygens-Freshnel equations for planar source problem • Describe and calculate two-dimensional Fourier transform • Understand and capable to calculate propagation of monochromatic light as Fourier transform	

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Fakultas Sekolah Teknik Elektro & Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL1200	***Bobot sks:*** 2	Semester**:** 2	***KK/Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Pengantar Analisis Rangkaian			
	Introduction to Circuit Analysis			
Silabus Ringkas	Konsep dasar, hukum-2 dasar, metoda analisis, teorema rangkaian, operational amplifier, kapasitor & induktor, rangkaian orde-1, rangkaian orde-2, rangkaian sinusoidal: fasor, pemodelan, dan analisa steady state rangkaian orde-1 dan 2.			
	Basic concepts, basic laws, methods of analysis, circuit theorems, operational amplifier, capacitors and inductors, first-order circuits, second-order circuits, sinusoidal circuits: phasors , circuit modelling, and steady state analysis of the 1st and 2nd order circuits.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	Basic Concept: Charge and current, Voltage, Power and energy, Circuit Elements. Basic Laws: Ohm's and Kirchhoff laws, series resistor & voltage divider, parallel resistors and current divider, delta-wye conversion. Methods of analysis: Nodal and Mesh. Circuit theorems: superposition, source transformation, Thevenin & Norton Theorems, maximum power transfer . Operational Amplifier: ideal op amps, inverting & non-inverting amplifier, summing, difference, and cascaded amplifiers. First-order circuits: source free and step response of RL and RC circuits, and singular function. Second-order circuits: source free and step response of series & paralle RLC circuits. Sinusoidal circuits: phasor concept, its relationships for circuits elements, circuits modelling and steady state analysis of 1st and 2nd order circuits			
Luaran (Outcomes)	At the end of this subject, students should be able to: 1. Understand the fundamental concepts of charge, current, voltage, power, energy, and circuit elements. 2. Apply basic laws (Ohm & Kirchhoff) for analysis resistive networks using nodal and mesh analysis. 3. Analyse resistive networks and simplify complicated networks using various circuit theorems (superposition, source transformation, Thevenin & Norton, maximum power transfer). 4. Analysis and design simple networks containing operational amplifier. 5. Deal with circuit containing energy storage elements. 6. Determine transient and steady state response of the first and second order circuits. 7. Perform 1st & 2nd order sinusoidal circuits modelling 8. Determine steady state analysis of 1st and 2nd order sinusoidal circuits 9. Use SPICE to analyst DC and AC circuits. 10. Use Matlab as a tool to solve the network problems.			
Matakuliah Terkait	FI1101 Fisika Dasar IA	Prerequisites		
	MA1101 Matematika IA	Prerequisites		
Kegiatan Penunjang	Penggunaan Tools (MATLAB dan SPICE)			
Pustaka	C.K. Alexander & M.N.O. Sadiku, Fundamentals of Electric Circuits, Mc Graw Hill, Fifth Edition, 2013 [Pustaka Utama]			
	R.C. Dorf & J. A. Svoboda, Introduction to Electric Circuits, John Wiley & Sons, Sixth Edition, 2004 [Pustaka Pendukung]			
Panduan Penilaian	Bobot penilaian: PR 15%, Kuis 15%, UTS 35% dan UAS 35%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Importance of Electric Circuits in Engineering World. *Basic Concept*	History & introduction Systems of units. Charge and current. Voltage. Power and energy. Circuit Elements. Applications	Know the importance of electric circuits in Engineering World. Understand relationship between charge & current, power & energy. *Know circuit elements and the metric units of electrical quantities*	*Alexander & Sadiku* : Chapter 1
2	*Basic Laws*	Ohm's law. Kirchhoff's laws. Series resistors and voltage division. Parallel resistors and current division. Wye-Delta transformations. Applications.	Analyze circuit SYSTEMS using direct application of Kirchoff's Current and Voltage Laws along with Ohm's Law.	*Alexander & Sadik: Chapter 2*
3	*Methods of Analysis*	Nodal analysis. Nodal analysis with voltage sources. Nodal Analysis by inspection.	Apply node-voltage analysis techniques to analyze circuit behavior. Apply cramer's rule and Gaussian elimination to solve simultaneous equations.	*Alexander & Sadiku: Chapter 3: 3.1 – 3.3, 3,6*
4	*Methods of Analysis*	Mesh analysis. Mesh analysis with current sources. Nodal analyses by inspection. Applications.	Apply mesh-current analysis techniques to analyze circuit behavior.	*Alexander & Sadiku: Chapter 3: 3.4 – 3.9*
5	*Circuits Theorems*	*Linearity property, superposition, source transformation.*	*Apply circuit theorems (superposition, source transformation) to analyze circuit behaviour.*	*Alexander & Sadiku: Chapter 4: 4.1 – 4.4*
6	*Circuits Theorems*	*Thevenin & Norton theorems, maximum power transfer. Applications.*	*Apply circuit theorems (Thevenin & Norton theorems, maximum power transfer) to analyze circuit behaviour.*	*Alexander & Sadiku: Chapter 4: 4.5 – 4.10*
7	*Operational Amplifiers*	*Ideal op-amp, inverting & non-inverting amplifiers.*	Analyse an ideal op. amp in various applications in dc circuits.	*Alexander & Sadiku: Chapter 5: 5.1 – 5.5*
8	*Operational Amplifiers*	*Summing & difference amplifiers, cascaded op amps circuits. Applications.*	Analyse an ideal op. amp in various applications in dc circuits.	*Alexander & Sadiku: Chapter 5: 5.6 – 5.10*
9	*Capacitors and Inductors*	Capacitors. Series and parallel capacitors. Inductors. Series and parallel inductors. Applications (differentiator, integrator, and analog computer).	Explain the characteristics of capacitor and inductor as a circuit element.	*Alexander & Sadiku: Chapter 6*
10	*First-Order Circuits*	Source-free RC circuits. Source-free RL circuits. Singularity functions.	Compute initial conditions for current and voltage in first order R-L and R-C capacitor and inductor circuits. Construct any waveform of signal using step and ramp functions.	*Alexander & Sadiku: Chapter 7: 7.1 – 7.4*
11	*First-Order Circuits*	Step response of an RC circuit. Step response of an RL circuit. First-order op amp circuits. Transient analysis	Compute time response of current and voltage in first order R-L and R-C circuits.	*Alexander & Sadiku: Chapter 7: 7.5 – 7.9*

		using SPICE. Applications.		
12	Second-Order Circuits	Finding initial and final values. Source-free series RLC circuits. Source-free parallel RLC circuits. Step response of a series RLC circuit. Step response of a parallel RLC circuit.	Compute initial conditions for current and voltage in second order RLC circuits. Compute time response of current and voltage in second order RLC circuits.	*Alexander & Sadiku: Chapter 8: 8.1 – 8.4*
13	Second-Order Circuits	General second-order circuits. Second-order op amp circuits. Duality. SPICE analysis of RLC circuits Applications.	Compute time response of current and voltage in general second order RLC circuits.	*Alexander & Sadiku: Chapter 8: 8.5 – 8.11*
14	Sinusoids and Phasors	Sinusoids. Phasors. Phasor relationships for circuits elements. Impedance and admittance.	*Understand the relationship between phasor concept and its diagram to sinusoidal signals and RLC elements in circuits.*	*Alexander & Sadiku: Chapter 9: 9.1 – 9.4*
15	Sinusoids and Phasors	Kirchhoff's laws in frequency domain. Impedance combinations. Applications.	*Understand the relationship between phasor concept and its diagram to sinusoidal signals and RLC elements in circuits.* Convert problems involving differential equations into circuit analysis problems using phasors and complex impedances	*Alexander & Sadiku: Chapter 9: 9.5 – 9.8*

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4093	***Bobot sks:*** 3	***Semester:*** 7/8	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Pengembangan Keprofesian & Komunitas			
	Proffession & Community Development			
Silabus Ringkas	Sebagai bagian dari pelatihan nyata, mahasiswa dapat mengikuti berbagai lomba/kompetisi nasional maupun internasional atau membuat kegiatan berbasis untuk masyarakat dalam bidang terkait rekayasa. Kegiatan akademik mahasiswa dalam mempersiapkan tim lomba/kompetisi tersebut mesti dilakukan dalam waktu minimal 4 bulan di masa semester berjalan.			
Silabus Lengkap	Sebagai bagian dari pelatihan nyata, mahasiswa dapat mengikuti berbagai lomba/kompetisi nasional maupun internasional atau membuat kegiatan berbasis untuk masyarakat dalam bidang terkait rekayasa. Kegiatan akademik mahasiswa dalam mempersipakan tim lomba/kompetisi tersebut mesti dilakukan dalam waktu minimal 4 bulan di masa semester berjalan.			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	Mahasiswa dapat mengapresiasi masalah nyata beserta berbagai kendala nyata Mahasiswa dapat mengembangkan soft-skill (bekrjasama, komunikasi, etika dll)			
Matakuliah Terkait	EL2005 Elektronika		Prasyarat	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	Kerja Mandiri terbimbing			
Pustaka	Rujukan Pilihan Terkait Topik Lomba/Kompetisi			
	Rujukan Buku Pilihan Pembimbing Lomba/Kompetisi/Exchange Program			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Written reports 25% Logbook 25% Poster and paper 25% Seminar/Progress 25%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Informasi, Aturan, dan Jadwal Kegiatan	[*Uraikan sub-topik bahasan*]	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Kegiatan Mandiri 1			
3	Kegiatan Mandiri 1			
4	Kegiatan Mandiri 2			
5	Kegiatan Mandiri 2			
6	Kegiatan Mandiri 3			
7	Kegiatan Mandiri 3			
8	Persiapan Penulisan Laporan			
9	Laporan Kemajuan Awal			
10	Kegiatan Mandiri 4			
11	Kegiatan Mandiri 4			
12	Kegiatan Mandiri 5			
13	Kegiatan Mandiri 5			
14	Persiapan Penulisan Laporan, Makalah, dan Pembuatan Poster			
15	Laporan Kemajuan Akhir			

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL3010	*3*	*5*	Prodi S1 Teknik Elektro	Wajib

Nama Matakuliah	Pengolahan Sinyal Digital
	Digital Signal Processing
Silabus Ringkas	Sejarah dan Tinjauan Pengolahan Sinyal Digital, Teori dan Konsep, Sinyal dan Sistem Waktu Diskrit, Analisis Sistem LTI dengan transformasi-z, Analisis frekuensi dari sinyal dan sistem, Discrete Fourier Transform (DFT) dan Fast Fourier Transform (FFT), Analisis Spektrum, Implementasi Sistem Waktu Diskrit, Perancangan Filter Digital
	History and Overview in Digital Signal Processing, Theories and Concepts, Discrete Time Signals and Systems, Analysis of LTI Systems Using z-Transfoms, Frequency Analysis of Signals and Systems, The Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Spectrum analysis, Implementation of Discrete-Time Systems, Design of Digital Filter
Silabus Lengkap	Sejarah dan tinjauan pengolahan sinyal digital; Teori dan konsep sinyal dan sistem, Konsep frekuensi di dalam sinyal waktu kontinyu dan sinyal waktu diskrit, dan Analog-to-Digital and Digital-to-Analog Conversion; Sinyal dan sistem waktu diskrit, Analisis sistem LTI waktu diskrit, dan Sistem LTI dikarakterisasi persamaan differens dengan koefisien konstan; Konsep transformasi-z dan inversinya, analisis sistem LTI menggunakan transformasi-z; Analisis frekuensi dari sinyal dan sistem, Sistem LTI sebagai frekuensi pemilih frekuensi; Discrete Fourier Transform (DFT) dan Fast Fourier Transform (FFT); Analisis spektrum dengan DFT dan konsep fungsi window; Implementasi sistem waktu diskrit untuk sistem FIR dan IIR; Perancangan filter digital, perancangan FIR, perancangan IIR dari filter analog yang ditransformasi menggunakan transformasi bilinear.
	History and overview in digital signal processing field; Theories and concepts of signal and system, the concept of frequency in continuous-time and discrete-time signals, and Analog-to-Digital and Digital-to-Analog Conversion; Discrete-time signals and systems, analysis of discrete-time LTI systems, and LTI system characterized by constant-coefficient difference equation (LCCDE); The concept of z-transform and its inversion, analysis of LTI systems using z-transfoms; Frequency analysis of signals and systems, LTI systems as frequency selective filters; The Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT); Spectrum Analysis using DFT and concept of window function; Implementation of Discrete-Time Systems for FIR and IIR systems; Design of digital filter, FIR designs, IIR designs from analog filters transformed using bilinear transformation.
Luaran (Outcomes)	Identify the difference between analog and discrete signals, Indicate some of the characteristic of filters; Describe the concept of frequency, amplitude, and phase of discrete time signals and continuous time signals and its properties, Explain the concept of Harmonically Related Complex Exponentials and fundamental frequency, Explain the process of analog-to-digital conversion (sampling, quantization, coding); Describe the discrete-time representation of signals, Distinguish between energy signals and power signals, periodic and aperiodic signals, symetric and antisymetric signals, Describe the input-output description of the systems and the their block diagram representation, Distinguish between time-invariant and time-variant systems, linear and nonlinear systems, causal and noncausal systems, stable and unstable systems, Apply the techniques for the analysis of Linear Systems; Describe the definition of z-transform and Region of Convergence (RoC), Explain the important properties of z-transform such as linearity, time shifting, scaling, and time reversal, Explain z-transform to characterize signals in terms of their pole-zero patterns, Explain the definition of inversion of the z-transform, Explain the methods for inverting the z-transform of a signal so as to obtain the time-domain representation of the signal, Apply the z-transform in the analysis of LTI systems; Explain the Fourier series representation for continuous-time periodic (power) signals and the Fourier transform for finite energy aperiodic signals, Explain the Fourier series representation for discrete-time periodic (power) signals and the Fourier transform for finite energy aperiodic signals, Explain the properties of the Fourier Transform (linearity, time shifting, and time-reversal), Explain the characterization of LTI systems in the frequency domain that is described by its frequency response, Produce the frequency response of LTI systems that have rational system functions, Apply the filter (LTI system) to perform spectral shaping or frequency-selective filtering; Explain the DFT and its properties (periodicity, linearity and circular symmetry), Apply the DFT to perform linear filtering in the frequency domain, Apply the DFT for frequency analysis of signals, Explain the FFT as a method for computing the DFT efficiently; Apply the DFT for spectrum analysis, Apply the linear filtering to compute DFT, Explain how window functions improve transform properties; Explain the issues in realization of Discrete-Time Systems, Explain the structures for FIR Systems (Direct Form, Cascade Form, Frequency Sampling Structure, Lattice Structure), Explain the structures for IIR Systems (Direct Form, Signal Flow Graphs and Transposed, Cascade Form, Parallel Form, Lattice and Lattice-Ladder Structures); Design Linear-Phase FIR Filters using windows (Rectangular, Berlett, Hanning, Hamming, Blackman), Design Linear-Phase FIR Filters by Frequency-Sampling Method, Design Optimum Equiripple Linear-Phase FIR Filters, Explain the concept of designing IIR filters from analog filters by the Bilinear Transformation, Design analog low pass filters (Butterworth, Chebyshev, Elliptic, and Bessel), Design IIR Filters from Analog Filters by the Bilinear Transformation (Low Pass, High Pass, Bandpass, Bandstop)

Matakuliah Terkait	EL2007 Sinyal dan Sistem	Prasyarat
	EL3110 Prakt. Pengolahan Sinyal Digital	Bersamaan
Kegiatan Penunjang	Tugas Proyek	
Pustaka	[PrMa07] J.G. Proakis and D. G. Manolakis, *Digital Signal Processing, Principles, Algorithms, and Applications*. Upper Saddle River, NJ: Prentice Hall, 2007. ISBN 0–13–2287315. (pustaka utama)	
	[InPr97] V. K. Ingle and J. G. Proakis, *Digital Signal Processing Using Matlab v.4.* Boston, MA: PWS Publishing Company, 1997. (pustaka pendukung untuk Tugas Proyek)	
Panduan Penilaian	Pretest (5%), Posttest (30), Tugas Proyek (30%), UAS (35%)	
Catatan Tambahan	Website penunjang perkuliahan ada di http://kuliah.itb.ac.id/course/view.php?id=287	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	History and Overview	• Reasons for studying DSP • Highlight some people that contributed in the area of DSP • The need for using transform • Some technique of transformations	• Identify the difference between analog and discrete signals • Indicate some of the characteristic of filters, in particular low- and high-pass filters • Describe how computer engineering uses or benefits from digital signal processing and multimedia	
2	Theories and Concepts	• Signals, systems, and signal processing • Classification of Signals • The concept of frequency in Continuous-Time and Discrete-Time Signals • Analog-to-Digital and Digital-to-Analog Conversion	• Express the definition and mathematical representation of signals and systems • Describe the basic elements of DSP systems • Distinguish between real and complex signals, multichannel and single channel, multidimensional and single dimensional, continuous time and discrete time, continuous valued and discrete valued, digital signal and analog signal, deterministic and random • Describe the concept of frequency, amplitude, and phase of discrete time signals and continuous time signals and its properties • Explain the concept of Harmonically Related Complex Exponentials and fundamental frequency • Explain the process of analog-to-digital conversion (sampling, quantization, coding) • Explain the concept of aliasing • Describe the process of digital-to-analog conversion	• [PrMa07] 1.1-1.5
3	Discrete Time Signals and Systems	• Discrete-Time Signals • Discrete-Time Systems • Analysis of Discrete-Time Linear Time-Invariant Systems	• Describe the discrete-time representation of signals • Explain the elementary signals (sample, step, ramp, exponential, complex exponential, sinusoidal) • Distinguish between energy signals and power signals, periodic and aperiodic signals, symetric and antisymetric signals • Explain the basic operation on signals (shifting, folding, addition, product, scaling) • Describe the input-output description of the systems and the their block diagram representation • Distinguish between static and dynamic systems, time-invariant and time-variant systems, linear and nonlinear systems, causal and noncausal systems, stable and unstable systems	• [PrMa07] 2.1-2.3
4	Discrete Time Signals and Systems	• Discrete-Time Systems Described by Difference Equations • Implementation of Discrete-Time	• Apply the techniques for the analysis of Linear Systems	• [PrMa07] 2.4-2.5
5	Analysis of LTI Systems Using z-Transfoms	• The z-Transform • Properties of the z-Transform • Rational z-Transforms • Inversion of the z-Transform • Analysis of LTI in the z-Domain	• Describe the definition of z-transform and Region of Convergence (RoC) • Explain the important properties of z-transform such as linearity, time shifting, scaling, and time reversal • Explain z-transform to characterize signals in terms of their pole-zero patterns • Explain the definition of inversion of the z-transform • Explain the methods for inverting the z-transform of a signal so as to obtain the time-domain representation of the signal	• [PrMa07] 3.1-3.4
6	Analysis of LTI Systems Using z-Transfoms	• One-Sided z-Transform • Analysis of LTI in the z-Domain	• Explain the definition of one-sided z-transform • Explain the properties of one-sided z-transform • Apply the z-transform in the analysis of LTI systems	• [PrMa07] 3.5
7	Frequency Analysis of Signals and Systems	• Frequency Analysis of Continuous-Time Signals	• Explain the Fourier series representation for continuous-time periodic (power) signals and the	• [PrMa07] 4.1-4.3

		• Frequency Analysis of Discrete-Time Signals	Fourier transform for finite energy aperiodic signals • Explain the Fourier series representation for discrete-time periodic (power) signals and the Fourier transform for finite energy aperiodic signals	
8	Frequency Analysis of Signals and Systems	• Properties of the Fourier Transform for Discrete-Time Signals • Frequency-Domain Characteristics of LTI Systems	• Explain the properties of the Fourier Transform (linearity, time shifting, and time-reversal) • Explain the characterization of LTI systems in the frequency domain that is described by its frequency response • Produce the frequency response of LTI systems that have rational system functions	• [PrMa07] 4.4, 5.1-5.2
9	Frequency Analysis of Signals and Systems	• LTI Systems as Frequency Selective Filters	• Apply the filter (LTI system) to perform spectral shaping or frequency-selective filtering	• [PrMa07] 5.3
10	The Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)	• The Discrete Fourier Transform (DFT) and Its Properties • Linear Filtering Methods Based on the DFT	• Explain the DFT and its properties (periodicity, linearity and circular symmetry) • Apply the DFT to perform linear filtering in the frequency domain	• [PrMa07] 7.1-7.3
11	The Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)	• Frequency Analysis of Signals Using the DFT • The Fast Fourier Transform (FFT)	• Apply the DFT for frequency analysis of signals • Explain the FFT as a method for computing the DFT efficiently • Explain the divide-and-conquer approach to derive fast algortihm for computing DFT (Radix-2 and Radix-4 FFT algorithms)	• [PrMa07] 7.4, 8.1-8.2
12	Spectrum Analysis	• Spectrum Analysis using DFT • Definition and purpose of a window function	• Apply the DFT for spectrum analysis • Explain the concept of zero padding • Apply the linear filtering to compute DFT and implement this on Goertzel Algorithm • Explain the definition of a window function • Explain why window functions are important to digital signal processing • Explain how window functions improve transform properties	• [PrMa07] 8.3-8.4
13	Implementation Discrete-Time Systems	• Structures for the Realization of Discrete-Time Systems • Structures for FIR Systems • Structures for IIR Systems	• Explain the issues in realization of Discrete-Time Systems • Explain the structures for FIR Systems (Direct Form, Cascade Form, Frequency Sampling Structure, Lattice Structure) • Explain the structures for IIR Systems (Direct Form, Signal Flow Graphs and Transposed, Cascade Form, Parallel Form, Lattice and Lattice-Ladder Structures)	• [PrMa07] 9.1-9.3
14	Design of Digital Filter	• FIR Filters	• The concept of symmetric and antisymmetric FIR filters • Design Linear-Phase FIR Filters using windows (Rectangular, Berlett, Hanning, Hamming, Blackman) • Design Linear-Phase FIR Filters by Frequency-Sampling Method • Design Optimum Equiripple Linear-Phase FIR Filters	• [PrMa07] 10.1-10.2
15	Design of Digital Filter	• IIR Filters	• Explain the concept of designing IIR filters from analog filters by the Bilinear Transformation • Design analog low pass filters (Butterworth, Chebyshev, Elliptic, and Bessel) • Design IIR Filters from Analog Filters by the Bilinear Transformation (Low Pass, High Pass, Bandpass, Bandstop) • Design IIR Filters by the Matched-z Transformation	• [PrMa07] 10.3-10.4

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2008	***Bobot sks:*** **3**	***Semester:*** **4**	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Penyelesaian Masalah dengan C			
	Problem Solving with C			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	This course lays the foundation of algorithm analysis and data structures for the electrical engineering curriculum. In this class, students will experience applications of concepts learned in the classroom. They will learn through hands-on experience how to read and understand problem statements and develop the algorithm and implement it using C to solve the problem.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
Luaran (Outcomes)	Provide an introduction to problem solving tools using an engineering workstation 1. Focus on teaching you the C programming language while emphasizing problem solving techniques and software engineering skills that are applicable in a wide variety of fields. 2. Provide students with the necessary skills to solve a variety of engineering and programming problems as needed throughout their undergraduate work.			
Matakuliah Terkait	KU1072 Introduction to Information Technology B		Prasyarat	
	EL2003 Struktur Diskrit		Prasyarat	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Hanly, Jeri, and Koffman, Elliot, "Problem Solving and Program Design in C", 5th ed, Addison Wesley, New York, 2007			
	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", The MIT Press, 3rd edition, 2009			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction	History and Overview	1. Identify some contributors to programming fundamentals and relate their achievements to the knowledge area. 2. Define the meaning of algorithm and data structure. 3. Know the reasons that a way to solve problems is by using algorithms. 4. Distinguish the difference between a stack and a queue. 5. Identify the difference between various programming paradigms. 6. Explain recursion and the way it works.	
2	Programming Construct	Variables, types, expressions, and assignment Simple I/O	1. Analyze and explain the behavior of simple programs involving the fundamental programming constructs covered by this unit. 2. Write a program that uses basic computation and simple I/O.	
3	Programming Construct	Conditional Structures	1. Analyze and explain the behavior of simple programs involving the fundamental programming constructs covered by this unit. 2. Write a program that uses standard conditional.	
4	Programming Construct	Iterative control structures, Pointers	1. Analyze and explain the behavior of simple programs involving the fundamental programming constructs covered by this unit. 2. Write a program that uses iterative structures and pointers.	
5	Programming Construct	Functions and parameter passing, File I/O	1. Analyze and explain the behavior of simple programs involving the fundamental programming constructs covered by this unit. 2. Write a program that uses procedure, functions, parameter passing, and File I/O.	
6	Algorithms and problem-solving	Problem-solving strategies, Structured decomposition Debugging strategies	1. Define the basic properties of an algorithm. 2. Develop algorithms for solving simple problems. 3. Use a suitable programming language to implement, test, and debug algorithms for solving simple problems. 4. Apply the techniques of structured decomposition to break a program into smaller pieces.	
7	Data Structure	Arrays and Records Strings and string processing	1. Identify data structures useful to represent specific types of information and discuss the tradeoffs among the different possibilities. 2. Write programs that use each of the following data structures: arrays, records, strings, linked lists, stacks, queues, and hash tables.	
8	Data Structure	Data representation in memory	1. Identify data structures	

		Static, stack, and heap allocation Runtime storage management Linked structures	useful to represent specific types of information and discuss the tradeoffs among the different possibilities. 2. Describe the way a computer allocates and represents these data structures in memory.	
9	Midterm			
10	Data Structure	Implementation strategies for stacks, queues, and hash tables Implementation strategies for graphs and trees	1. Identify data structures useful to represent specific types of information and discuss the tradeoffs among the different possibilities.	
11	Recursion	The concept of recursion Recursive mathematical functions Divide-and-conquer strategies Recursive backtracking	1. Explain the concept of recursion. 2. Explain the structure of the divide-and-conquer approach. 3. Write, test, and debug simple recursive functions and procedures. 4. Describe how recursion can be implemented using a stack	
12	Basic Algorithm Analysis	Asymptotic analysis of upper and average complexity bounds Identifying differences among best, average, and worst case behaviors	1. Determine the time complexity of simple algorithms. 2. Deduce the recurrence relations that describe the time complexity of recursively-defined algorithms, and solve simple recurrence relations.	
13		Big "O," little "o," omega, and theta notation Empirical measurements of performance Time and space tradeoffs in algorithms	Use big O, omega, and theta notation to give asymptotic upper, lower, and tight bounds on time and space complexity of algorithms.	
14	Algorithm Strategy	Brute-force/exhaustive search algorithms Greedy algorithms	Design algorithms using the brute-force, greedy, and divide-and-conquer strategies.	
15	Algorithm Strategy	Divide-and-conquer Backtracking	Design an algorithm using at least one other algorithmic strategy from the list of topics for this unit.	
16	Computing Algorithm	Simple numerical algorithms	Use and implement the fundamental abstract data types—specifically including hash tables, binary search trees, and graphs—necessary to solve algorithmic problems efficiently.	
17	Computing Algorithm	Sequential and binary search algorithms Sorting algorithms Hash tables Binary search trees	1. Solve problems using efficient sorting algorithms, and fundamental graph algorithms, including depth-first and breadth-first search, single-source and all-pairs shortest paths, transitive closure, topological sort, and at least one minimum spanning tree algorithm. 2. Demonstrate the following abilities: to evaluate algorithms, to select from a range of possible options, to provide justification for that selection, and to implement the algorithm in simple programming contexts	
18	Intro to Parallel and Distributed	Why parallel computation?, Task/Thread, concurrency, OpenMP	1. Discuss the concept of parallel processing beyond the classical von Neumann model. 2. Describe alternative architectures such as SIMD, MIMD, and VLIW.	

			3. Explain the concept of interconnection networks and characterize different approaches. 4. Discuss the special concerns that multiprocessing systems present with respect to memory management and describe how these are addressed. 5. Explain the distributed paradigm. 6. Explain one simple distributed algorithm 7. Explain the various method of communication method for data movement with a specific topology 8. Understand the types of problem can be parallelize and the limit of performance gain 9. Write a program that uses all programming concept of MPI, OpenMP, and CUDA.	
19	Final Exam			

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3111	***Bobot sks:*** 1	***Semester:*** 3	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Praktikum Arsitektur Sistem Komputer			
	Computer System Architecture Laboratory			
Silabus Ringkas	Mata kuliah praktikum ini memberikan pemahaman tentang teknik implementasi prosessor modern			
	This course is intended for undergraduate student so that the student will gain a comprehensive knowledge of computer hardware and its interaction with software. The course will also stress on simple MIPS processor design and implementation using VHDL.			
Silabus Lengkap	Mata kuliah praktikum ini memberikan pemahaman tentang teknik implementasi prosessor modern. Implementasi prosessor menggunakan VHDL. Pengujian kerja prosessor dan simulasi setiap bagian prosessor menggunakan alat-alat perancangan modern.			
Luaran (Outcomes)	Praktikum ini menunjang konsep-konsep yang diberikan dalam mata kuliah Arsitektur Sistem Komputer . 1. Memahami konsep implementasi prosesor modern 2. Memahami teknik implementasi prosessor menggunakan VHDL			
Matakuliah Terkait	EL2102 Praktikum Sistem Digital		Prasyarat	
	EL3011 Arsitektur Sistem Komputer		Bersamaan	
Kegiatan Penunjang				
Pustaka	Randal E. Bryant, David R., Computer Systems A Programmer's Perpective, 2nd Ed, 2010 [CSAP]			
	John L. Hennessy and David A. Patterson , Computer Organization and Design: The Software Hardware Interface, Morgan Kaufmann Publishers, Fourth Edition, 2009. [P&H]			
	Lab Manuals			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	***Topik***	***Sub Topik***	***Capaian Belajar Mahasiswa***	***Sumber Materi***
1	Implementasi ALU	1. Implementasi Operasi Logika 2. Implementasi Operasi Aritmatika 3. Pengujian		
2	Implementasi Register File, Memori Instruksi, dan Memori Data	1. Implementasi Register File 2. Implementasi Memori Instruksi 3. Implementasi Memori Data 4. Pengujian		
3	Implementasi PC dan Branch	1. Implementasi PC dan PC+4 2. Implementasi Branch 3. Pengujian		
4	Implementasi Kontrol Unit	1. Implementasi Kontrol Unit Single Cycle 2. Pengujian		
5	Penggabungan semua unit dalam Prosessor	Pengujian Prosessor		

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL3109	1	5	Prodi S1 Teknik Elektro	Wajib

Nama Matakuliah	Praktikum Elektronika II
	Electronics Laboratory II
Silabus Ringkas	Tahap output dan penguat daya; Karakteristik amplifier diferensial dan respon frekuensi penguat; Penguat umpan balik dan sifat-sifatnya; Osilator; Regulator tegangan: linear dan beralih-mode.
	Output stage and power amplifiers; Characteristics of the differential amplifiers and Frequency response of amplifiers. Feedback amplifiers and their properties. Oscillators; Voltage regulators: linear and switch-mode.
Silabus Lengkap	Mata kuliah ini adalah praktikum kedua untuk elektronik. Dalam praktikum ini, mahasiswa bekerja dengan rangkaian penguat diferensial, penguat multi transistor, tahap output penguat daya dan penguat umpan balik, rangkaian pembangkitan sinyal: osilator, pembentuk sinyal dan multivibrators astabil, rangkaian regulasi tegangan linier dan switched-mode. Setelah menyelesaikan kuliah ini, mahasiswa diharapkan dapat memahami sifat bagian penguat secara lengkap dan menggunakannya dalam perancangan penguat, memilih, menganalisa, dan membangun rangkaian osilator dan regulator sesuai spesifikasi yang diberikan dalam tugas perancangan.
	This course is the second lab for electronics. In this lab, students work with a differential amplifier circuit, multi-transistor amplifier, power amplifier output stage and feedback amplifiers, signal generation circuits: oscillators, signal shapers and astable multivibrators, linear voltage regulation circuits and switched-mode. After completing this course, students are expected to understand fully the properties of the building blocks for amplifier and to use them in the amplifier design, select, analyze, and construct the oscillator and the regulator circuits to the specifications given in a design project.
Luaran (Outcomes)	11. Understand the classification of the final stage of the power amplifier and circuit design required for the application, measure and evaluate the efficiency of a power amplifier and design the required heatsink for its thermal dissipation. 12. Design differential amplifiers to meet large-signal swing and small-signal gain specifications and confirm the design with actual circuits. 13. Relate capacitance in devices to the frequency performance of circuits and estimate the bandwidth of an amplifer. 14. Determine the loaded gain of a feedback amplifier using two-ports, predict the stability using Bode plots, andcompare with the result of measurements of actual circuits. 15. Analyze and design various types of oscillators and multivibrators. 16. Understand the principles of voltage regulation, choosing regulator topology for the desired application, build a voltage regulation circuit using IC regulator to the given specifications.
Matakuliah Terkait	EL2205 Praktikum Elektronika — Prasyarat
	EL3009 Elektronika II — Bersamaan
Kegiatan Penunjang	
Pustaka	A. Sedra and K. Smith, Microelectronic Circuits International 6th ed., Oxford University Press, 2011
	Thomas L Floyd, Electronic Devices 9th ed, Prentice Hall, 2011
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Introduction	• Classroom and Lab Rules and Regulation • Laboratory Note Book • Lab Safety	• Connect the lab rulesand regulations to the lab activities • Write important information before, during and after the lab activities • Cite lab safety while in labs • Learn how to write a proper lab report (both content and presentation).	Lab Manual and Class Hand-outs
2	• Output stage and power amplifier	• Output stage classification: bias, waveform, and power efficiency • Class AB power amplifier circuits	• Compare the trade-off of distortion and the power efficiency among varios class of output stage • Design bias circuit for the class AB pushpull amplifiers	Lab Manual and Class Hand-outs
3	• Output stage and power amplifier	• Power dissipation, thermal modelling, and heatsink selection	• Design heat sink for a required power dissipation of power amplifiers	Lab Manual and Class Hand-outs
4	• Differential and multitransistor amplifiers	• Differential pairs: gain and CMRR • Current Sink/ Source in differential amplifier	• Measure the CMRR of a different amplifier • Identify the effect of current source resistance in differential amlifier	Lab Manual and Class Hand-outs
5	• Differential and multitransistor amplifiers	• Load resistance in differential amplifier • Differential amplifier with active load	• Identify the effect of load resistance in differential amlifier • Identify the benefit of active load in differential amlifier	Lab Manual and Class Hand-outs
6	• Frequency response	• Single transistor amplifiers	• Analyse the frequency response of an ampifiers • Identify the components that most effecting components	Lab Manual and Class Hand-outs
7	• Frequency response	• Cascode amplifiers	• Differentiate the amplifier architecturesfor their frequency response performance	Lab Manual and Class Hand-outs
8	• Review 2	•	•	
9	• Feedback amplifiers	• Small signal amplifier with feedback circuits • Feedback amplifier configuration	• Identify the impact of feedback in amplifier gains • Identify the impact of feedback in amplifier input and output resistance	Lab Manual and Class Hand-outs
10	• Feedback amplifiers	• Feedback and amplifier pole frequency • Feedback and power amplifier	• Identify the impact of feedback in frequency response • Identify the impact of feedback in distortion	Lab Manual and Class Hand-outs
11	• Oscillators and multivibrators	• RC oscillators • LC oscillators	• Understand the positive feedback mechanism for oscillators and how they are implemented • Understand the requirement of amplifier gainof oscillators to start oscillation	Lab Manual and Class Hand-outs
12	• Oscillators and multivibrators	• Xtal oscillators • Multivibrators	• Design oscillators and multivibrators for a given specification	Lab Manual and Class Hand-outs
13	• Voltage regulators	• Liniear voltage regulator: shunt and series configuration • Switching regulators: boost and buck	• Understand the principle of regulations • Calculate the power efficiency in regulators	Lab Manual and Class Hand-outs
14	• Voltage regulators	• IC regulators	• Apply IC regulators in design of voltage regulators	Lab Manual and Class Hand-outs
15	• Review 2	•	•	

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL2205	**1**	**4**	**Prodi S1 Teknik Elektro**	Wajib

Nama Matakuliah	Praktikum Elektronika
	Electronics Laboratory
Silabus Ringkas	Pengamatan dan penentuan karakteristik device semikonduktor. Sirkuit-sirkuit dioda. Penentuan bias DC. Penguat transistor tunggal dengan BJT dan MOSFET. Transistor sebagai saklar. Perancangan dan implementasi penguat sederhana dengan transistor pada PCB.
	IV characteristization of the semiconductor devices. Diode circuits. Determination of DC bias. Single transistor amplifiers with BJT and MOSFET. Transistors as switches. Design and implementation of transistor amplifiers on PCB.
Silabus Lengkap	Mata kuliah ini adalah praktikum untuk mata kuliah elektronik. Dalam mata kuliah ini, mahasiswa mengukur dan mengamati karakteristik IV perangkat semikonduktor dioda, BJT dan MOSFET; sirkuit dioda penyearah dengan filter RC-nya, clipper, dan clamping; mengamati dan menentukan bias tegangan dan arus pada transistor penguat; mengukur dan membandingkan resistansi input, gain, dan resistansi output pada penguat CE, CC, dan CB untuk BJT dan CS, CD, dan CG untuk MOSFET; mengamati penggunaan transistor sebagai saklar dan keterbatasannya; melakukan siklus perancangan hingga implementasi penguat transistor pada PCB untuk spesifikasi yang diberikan.
	This course is a laboratory course for electronics. In this course, students measure and observe the IV characteristics of a semiconductor device diode, BJT and MOSFET; diode rectifier circuits with RC filters, clipper and clamping circuits; determine the bias voltage and current in a transistor amplifier; measure and compare of the input resistance, gain, and output resistance of the amplifier CE, CC, and CB for the BJT and CS, CD and CG for the MOSFET; observe the use of transistors as switches and their limitations; perform cycle transistor amplifier design to implementation on the PCB for a given specification.
Luaran (Outcomes)	17. Expand the mastery of use of the lab instruments, SPICE simulator, and PCB design tools. 18. Produce plots of IV characteristics for Diode, BJT and MOSFET and point out what cause certain important parts of the plots. 19. Sketch the output of halfwave and fullwave diode rectifiers with RC filters, shows the ripple effect of the RC filter and diode current. 20. Sketch the voltage transfer characteristics of clipper and clamping circuits. 21. Survey the bias of transistor and itseffect on small signal current amplification linearity. 22. Measure, analyse and compare the input resistance, gain and output resitance of of the amplifier CE, CC, and CB for the BJT and CS, CD and CG for the MOSFET; 23. Point out the limitation of BJT as current controlled switch and the advantages of CMOS inverter through the measurement results. 24. Design and construct a transistor amplifier for a given specification. 25. Produce PCB lay out and BOM for the group design. 26. Test and evaluate the design and discuss the results and conclusion in the report.
Matakuliah Terkait	EL2005 Elektronika — Bersamaan
	EL2101 Praktikum Rangk. Elektrik — Prasyarat
Kegiatan Penunjang	
Pustaka	
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Introduction	• Classroom and Lab Rules and Regulation • Laboratory Note Book • Lab Safety	• Connect the lab rulesand regulations to the lab activities • Write important information before, during and after the lab activities • Cite lab safety while in labs • Learn how to write a proper lab report (both content and presentation).	Lab Manual and Class Hand-outs
2	• Diodes	• Diode IV characterization • Silicon, Germanium, and Zener Diode IV characterics	• Apply the scheme for ploting IV characteristics of two terminal devices on an oscilloscope • Produce plots of IV characteristics	

			for Diode point out what cause certain important parts of the plots.	
3	• Diodes	• Diode rectifier circuits • RC filter for diode rectifiers • Clipper circuits • Clamping circuits	• Sketch the output of halfwave and fullwave diode rectifiers with RC filters • Shows the ripple effect of the RC filter and diode current. • Sketch the voltage transfer characteristics of clipper and clamping circuits.	
4	• BJT IV charaterization and Bias Point Selection	• BJT IV characterization: Base and collector current vs base-emitor voltage • collector current vs collctor-emitor voltage and base current	• Produce plots of IV characteristics for BJT and point out what cause certain important parts of the plots.	
5	• BJT IV charaterization and Bias Point Selection	• BJT Operation regions and current gain liniearity	• Survey the bias of transistor and itseffect on small signal current amplification linearity.	
6	• Single BJT Amplifier Configurations	• Amplifier properties: input resistance, gain, and output resistance • Measuremet techniques for input resistance, gain, and output resistance	• Write and construct the amplifier properties observation and measurement schemes.	
7	• Single BJT Amplifier Configurations	• Properties of CE, CC, and CB amplifiers.	• Measure, analyse and compare the input resistance, gain and output resitance of of the amplifier CE, CC, and CB for the BJT.	
8	• Review 1	•	•	
9	• MOSFET IV Characteristics and Amplifier	• MOSFET operation regions and current gain liniearity	• Survey the bias of transistor and itseffect on small signal current amplification linearity.	
10	• MOSFET IV Characteristics and Amplifier	• Properties of CS, CD, and CG amplifiers.	• Measure, analyse and compare the input resistance, gain and output resitance of of the amplifier CS, CD and CG for the MOSFET;	
11	• BJT and MOSFET as Switches	• BJT in cut-off and saturation regions • MOSFET cut-off and triode regions • MOSFET inverters	• Point out the limitation of BJT as current controlled switch. • Show the advantages of CMOS inverter through the measurement results.	
12	• Amplifier Design and Implementation	• Manual design • SPICE simulation and design iteration	• Expand the mastery of use of the lab instruments, SPICE simulator, and PCB design tools. • Design a transistor amplifier for a given specification. • Simulate the design and design iteration to get accepted results	
13	• Amplifier Design and Implementation	• Component selections PCB design and PCBdesign tools • Design testing scheme for amplifier	• Produce BOM for the group design. • Produce PCB lay out • Produce testing and evaluation scheme for the amplifier	
14	• Amplifier Design and Implementation	• PCB construction	• Construct a transistor amplifier Produce BOM for the group design. • Test and evaluate the design and discuss the results and conclusion in the report.	
15	• Review 2	•	•	

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL3110	**1**	**5**	**Prodi S1 Teknik Elektro**	Wajib
Nama Matakuliah	Praktikum Pengolahan Sinyal Digital			
	Digital Signal Processing Laboratory			
Silabus Ringkas	Pengenalan MATLAB, Simulasi filter FIR realtime, Visual DSP++ 5.0, Disain filter dan implementasi algoritma DSP, Implementasi algoritma DSP lanjut, Disain dan implementasi filter IIR menggunakan Blackfin DSP Processor			
	Introduction to MATLAB, Simulation of Realtime Finite Impulse Response Filter, Visual DSP++ 5.0, Filter Design and Implementation of DSP Algorithm, Implementation of Advanced DSP Algorithm, Design and Implementation of Infinite Impulse Response Filter using Blackfin DSP Processor			
Silabus Lengkap	Pengenalan MATLAB, MATLAB untuk pemrosesan sinyal, Menulis fungsi MATLAB, Filtering realtime vs offline, Algoritma filtering realtime, Isu numerik di prosesor DSP, Pengenalan Visual DSP++ Integrated Development Environment, Audio talkthrough menggunakan Blackfin DSP, Pemrosesan audio sederhana menggunakan Blackfin DSP, Algoritma filtering menggunakan Blackfin DSP, Implementasi Low Pass Filter menggunakan Blackfin DSP, Implementasi High Pass Filter menggunakan Blackfin DSP, Implementasi Band Pass Filter menggunakan Blackfin DSP, Pengukuran respon frekuensi dari filter menggunakan white noise, Algoritma voice scrambler sederhana, Algoritma stereo widening, Disain filter IIR, Implementasi filter IIR			
	Introduction to MATLAB, MATLAB for signal processing, Writing custom MATLAB function, Realtime vs offline filtering, Algoritma realtime filtering, Numerical Issues in DSP processor, Introduction to Visual DSP++ Integrated Development Environment, Audio Talkthrough using Blackfin DSP, Simple Audio Processing using Blackfin DSP, FIR filtering algorithm using Blackfin DSP, Implementation of Low Pass Filter using Blackfin DSP, Implementation of High Pass Filter using Blackfin DSP, Implementation of Band Pass Filter using Blackfin DSP, Measurement of frequency response of implemented filter using white noise, Simple Voice Scrambler Algorithm, Stereo widening algorithm, Infinite Impulse Response Filter Design, Infinite Impulse Response Filter implementation			
Luaran (Outcomes)	Explain how to use MATLAB functions that related to signal processing, Produce digital signal using MATLAB, Analyze spectra of digital signal using MATLAB, Produce FIR filter coefficient using fir1 and fir2, Produce and analyze frequency response of FIR filter, Produce digital signal output specified by input and LCCDE coefficient, Develop FIR filtering algorithm, Distinguish realtime filtering vs offline filtering algorithm, Develop, simulate and verify realtime FIR filtering algorithm using C programming, Apply circular buffer concept to FIR filtering algorithm, Explain advantages using fractional integer, Develop, simulate and verify realtime FIR filtering algorithm using C programming using fractional integer, Explain audio talkthrough source code for Blackfin DSP processor, Apply simple audio processing algorithm to Blackfin DSP processor, Apply FIR filtering algorithm using circular buffering to Blackfin DSP processor, Apply Low Pass FIR filter to Blackfin DSP processor, Apply High Pass FIR filter to Blackfin DSP processor, Apply Band Pass FIR filter to Blackfin DSP processor, Explain how to measure frequency response of filter using white noise, Produce and Analyze frequency response of implemented filter using DSP hardware, Apply simple voice scrambler algorithm to Blackfin DSP processor, Apply stereo widening algorithm to Blackfin DSP processor, Produce Butterworth IIR filter coefficient using MATLAB Compare and Analyze Butterworth IIR filter coefficient to specification, Apply IIR filter algorithm to Blackfin DSP processor, Produce and Analyze frequency response of implemented filter using DSP hardware			
Matakuliah Terkait	EL3010 Pengolahan Sinyal Digital	Bersamaan		
Kegiatan Penunjang				
Pustaka	[PrMa07] J.G. Proakis and D. G. Manolakis, *Digital Signal Processing, Principles, Algorithms, and Applications*. Upper Saddle River, NJ: Prentice Hall, 2007. ISBN 0–13–2287315.			
	[InPr97] V. K. Ingle and J. G. Proakis, *Digital Signal Processing Using Matlab v.4.* Boston, MA: PWS Publishing Company, 1997.			
Panduan Penilaian				
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction to MATLAB	• Introduction to MATLAB • MATLAB for signal processing • Writing custom MATLAB function	• Explain how to use MATLAB functions that related to signal processing • Produce digital signal using MATLAB • Analyze spectra of digital signal using MATLAB • Produce FIR filter coefficient using fir1 and fir2 • Produce and analyze frequency response of FIR filter • Produce digital signal output specified by input and LCCDE coefficient • Develop FIR filtering algorithm	Modul 1
2	Simulation of Realtime Finite Impulse Response Filter	• Realtime vs offline filtering • Algoritma realtime filtering • Numerical Issues in DSP processor	• Distinguish realtime filtering vs offline filtering algorithm • Develop, simulate and verify realtime FIR filtering algorithm using C programming • Apply circular buffer concept to FIR filtering algorithm • Explain advantages using fractional integer • Develop, simulate and verify realtime FIR filtering algorithm using C programming using fractional integer	Modul 2
3	Visual DSP++ 5.0	• Introduction to Visual DSP++ Integrated Development Environment • Audio Talkthrough using Blackfin DSP • Simple Audio Processing using Blackfin DSP • FIR filtering algorithm using Blackfin DSP	• Explain audio talkthrough source code for Blackfin DSP processor • Apply simple audio processing algorithm to Blackfin DSP processor • Apply FIR filtering algorithm using circular buffering to Blackfin DSP processor	Modul 3
4	Filter Design and Implementation of DSP Algorithm	• Implementation of Low Pass Filter using Blackfin DSP • Implementation of High Pass Filter using Blackfin DSP • Implementation of Band Pass Filter using Blackfin DSP • Measurement of frequency response of implemented filter using white noise	• Apply Low Pass FIR filter to Blackfin DSP processor • Apply High Pass FIR filter to Blackfin DSP processor • Apply Band Pass FIR filter to Blackfin DSP processor • Explain how to measure frequency response of filter using white noise • Produce and Analyze frequency response of implemented filter using DSP hardware	Modul 4
5	Implementation of Advanced DSP Algorithm	• Simple Voice Scrambler Algorithm • Stereo widening algorithm	• Apply simple voice scrambler algorithm to Blackfin DSP processor • Apply stereo widening algorithm to Blackfin DSP processor	Modul 5
6	Design and Implementation of Infinite Impulse Response Filter using Blackfin DSP Processor	• Infinite Impulse Response Filter Design • Infinite Impulse Response Filter implementation	• Produce Butterworth IIR filter coefficient using MATLAB • Compare and Analyze Butterworth IIR filter coefficient to specification • Apply IIR filter algorithm to Blackfin DSP processor • Produce and Analyze frequency response of implemented filter using DSP hardware	Modul 6

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2208	***Bobot sks:*** **1**	***Semester:*** Genap	***Unit Penanggung Jawab:*** Program Studi Sarjana TE	***Sifat:*** Wajib Prodi
Nama Matakuliah	Praktikum Penyelesaian Masalah dengan C			
	Problem Solving with C Laboratory			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	This course provides the foundation of algorithm analysis and data structures for the electrical engineering curriculum. In this class, students will experience applications of concepts learned in the classroom through pratical lab works. They will learn through hands-on experience how to read and understand problem statements and develop the algorithm and implement it using C to solve the problem.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
Luaran (Outcomes)	Provide an introduction to problem solving tools using an engineering workstation 1. Focus on teaching you the C programming language while emphasizing problem solving techniques and software engineering skills that are applicable in a wide variety of fields. 2. Provide students with the necessary skills to solve a variety of engineering and programming problems as needed throughout their undergraduate work.			
Matakuliah Terkait	EL2008 Problem Solving with C		Bersamaan/co-requisite	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Hanly, Jeri, and Koffman, Elliot, "Problem Solving and Program Design in C", 5th ed, Addison Wesley, New York, 2007			
	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", The MIT Press, 3rd edition, 2009			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction	Compiling usning GNU		
2	Programming Construct	Variables, types, expressions, and assignment Simple I/O		
3	Programming Construct	Conditional Structures	.	
4	Programming Construct	Iterative control structures, Pointers		
5	Programming Construct	Functions and parameter passing, File I/O		
6	Data Structure	Arrays and Records		
7	Data Structure	Strings and string processing	.	
8	Data Structure	Data representation in memory Static, stack, and heap allocation Runtime storage management Linked structures		
9	Data Structure	Implementation strategies for stacks, queues, and hash tables Implementation strategies for graphs and trees		
10	Recursion	The concept of recursion Recursive mathematical functions Divide-and-conquer strategies Recursive backtracking		
11	Algorithm Strategy	Divide-and-conquer Backtracking		
12	Computing Algorithm	Simple numerical algorithms		
13	Computing Algorithm	Sequential and binary search algorithms Sorting algorithms		
14	Computing Algorithm	Complex Algebra		
15	Computing Algorithm	Sound Processing		
16	Computing Algorithm	Image Processing		

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2208	***Bobot sks:*** **1**	***Semester:*** Genap	***Unit Penanggung Jawab:*** Program Studi Sarjana TE	***Sifat:*** Wajib Prodi
Nama Matakuliah	Praktikum Penyelesaian Masalah dengan C			
	Problem Solving with C Laboratory			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	This course provides the foundation of algorithm analysis and data structures for the electrical engineering curriculum. In this class, students will experience applications of concepts learned in the classroom through pratical lab works. They will learn through hands-on experience how to read and understand problem statements and develop the algorithm and implement it using C to solve the problem.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
Luaran (Outcomes)	Provide an introduction to problem solving tools using an engineering workstation 1. Focus on teaching you the C programming language while emphasizing problem solving techniques and software engineering skills that are applicable in a wide variety of fields. 2. Provide students with the necessary skills to solve a variety of engineering and programming problems as needed throughout their undergraduate work.			
Matakuliah Terkait	EL2008 Problem Solving with C		Bersamaan/co-requisite	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Hanly, Jeri, and Koffman, Elliot, "Problem Solving and Program Design in C", 5th ed, Addison Wesley, New York, 2007			
	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", The MIT Press, 3rd edition, 2009			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction	Compiling usning GNU		
2	Programming Construct	Variables, types, expressions, and assignment Simple I/O		
3	Programming Construct	Conditional Structures	.	
4	Programming Construct	Iterative control structures, Pointers		
5	Programming Construct	Functions and parameter passing, File I/O		
6	Data Structure	Arrays and Records		
7	Data Structure	Strings and string processing	.	
8	Data Structure	Data representation in memory Static, stack, and heap allocation Runtime storage management Linked structures		
9	Data Structure	Implementation strategies for stacks, queues, and hash tables Implementation strategies for graphs and trees		
10	Recursion	The concept of recursion Recursive mathematical functions Divide-and-conquer strategies Recursive backtracking		
11	Algorithm Strategy	Divide-and-conquer Backtracking		
12	Computing Algorithm	Simple numerical algorithms		
13	Computing Algorithm	Sequential and binary search algorithms Sorting algorithms		
14	Computing Algorithm	Complex Algebra		
15	Computing Algorithm	Sound Processing		
16	Computing Algorithm	Image Processing		

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK/Unit Penanggung Jawab:*	*Sifat:*
EL2101	**1**	**3**	**Prodi S1 Teknik Elektro**	Wajib

Nama Matakuliah	Praktikum Rangkaian Elektrik
	Measurement and Circuit Laboratory
Silabus Ringkas	Penguasaan instrumen laboratorium. Percobaan dengan rangkaian dasar dengan resistor, kapasitor, induktor, dan op-amp. Rangkaian DC and teorema rangkaian, rangkaian opamps, gejala transient, impedansi, prinsip frekuensi respon, rangkaian resonansi.
	Familiarization with lab instruments. Experiments with basic circuits containing resistors, capacitors, inductors, and op-amps. DC circuits and circuit theorems, circuits with opamps, transient phenomena, impedances, frequency response principles, resonance circuits.
Silabus Lengkap	Mata kuliah ini merupakan mata kuliah praktikum. Dalam praktikum ini, mahasiswa akan belajar menggunakan: meltimeter, osiloskop, generator fungsi, catu daya dan aksesorisnya. Percobaan yang dilakukan mencakup sirkuit DC dan teorema sirkuit, sirkuit dengan opamp, gejala transient, rangkaian ac, impedansi, fasor dan respons frekuensi, rangkaian resonansi. Setelah menyelesaikan mata kuliah ini, mahasiswa diharapkan menguasi penggunaan instrumen laboratorium, memahami fenomena dan teori dalam rangkaian, dan mampu menggunakan opamp untuk implementasi fungsi sederhana.
	This course in a laboratory course. In this class student will familiarize themself with laboratory instruments: Multimeter, Oscilloscope, Signal Generators, Regulated Power Supply and their accessories. Experiments conducted include DC circuits and circuit theorems, circuits with opamps, transient symptoms, AC circuits, impedance, phasors and frequency response, and resonant circuit. After completing this course, students are expected to master the use of laboratory instruments, to understand phenomena and theories in the series, and was able to use opamp to implement simple functions.
Luaran (Outcomes)	27. Use of laboratory instruments: multimeter, oscilloscope, function generator, regulated power supply. 28. Understand and compare circuit theorems with actual working circuits. 29. Understand how Thevenin, Norton, and Superposition Theorems, simplify circuit analyses. 30. Understand and design simple math functions with opamp circuits. 31. Understand and design an oscillator circuit using an opamps. 32. Understand and contrast the transient phenomena in electric circuits. 33. Learn about AC signals and the concept of phasor and impedance. 34. Observe and understand the behavior of RC and RL circuits as LPF and HPF and as integrator and differentiator. 35. Understand the Bode plot of a signal transfer ratio. 36. Design and understand RLC circuits, both parallel and series. 37. Learn how to write a proper lab report (both content and presentation).
Matakuliah Terkait	EL2001 Rangkaian Elektrik — Prasyarat
	[*Kode dan Nama Matakuliah*]
Kegiatan Penunjang	
Pustaka	
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Introduction	• Classroom and Lab Rules and Regulation • Laboratory Note Book • Lab Safety	• Connect the lab rulesand regulations to the lab activities • Write important information before, during and after the lab activities • Cite lab safety while in labs • Learn how to write a proper lab report (both content and presentation).	Lab Manual and Class Hand-outs
2	• Lab instruments: Multimeter, regulated poer supply, and function generator.	• Voltage and current measurement for AC and DC and intrument limitations • Resistance measuments: 2W and 4W	• Use of laboratory instruments: multimeter, oscilloscope, function generator, regulated power supply. • Interpret schematic circuits to construct measurement set up • Perform measurements of voltage and currents both AC and DC and resistance. • Observe, compare, and discuss the limitation of lab instruments	Lab Manual and Class Hand-outs
3	• Lab instruments: Oscilloscope	• Checking the instrument calibration • Reading the voltage, frequency, and phase difference. • Use oscilloscope for ploting IV characteristics of two terminal devices	• Perform the oscilloscope calibration checking and justify the measurement results done with the instruments • Perform, observe, and record the physical quantity being measured • Compare the results to the expected values and discuss the observation • Construct and perform the circuit and scheme for ploting IV characteristics of two terminal devices on an oscilloscope	Lab Manual and Class Hand-outs
4	• DC Circuits and Circuit Theorems	• Basic circuit laws: Ohm and Kirchoff • Thevenin and Norton Theorems • Maximum power transfer	• Understand and compare circuit theorems with actual working circuits. • Understand how Thevenin, Norton, and Superposition Theorems, simplify circuit analyses.	Lab Manual and Class Hand-outs
5	• DC Circuits and Circuit Theorems	• Superposition theorem • Reciprocity theorem	•	Lab Manual and Class Hand-outs
6	• Circuits with Opamp	• Basic opamp circuits: inverting, noninverting, summing amplifiers, integrator and differentiators	• Understand and design simple math functions with opamp circuits.	Lab Manual and Class Hand-outs
7	• Circuits with Opamp	• Implementing math function in opamp circuits • Opamp nonidealities	• Understand and design an oscillator circuit using an opamps. •	Lab Manual and Class Hand-outs
8	• Review 1	•	•	
9	• Transient Phneomena	• General first order response • Reading the time constant • Observations on the effect of resistance and capacitance to the time constant	• Understand and contrast the transient phenomena in electric circuits. • Perform, observe, and record the time contant of a first order circuit in the time domain measurements • Observe the effect of resistance and capacitance to the time constant	Lab Manual and Class Hand-outs
10	• Transient Phneomena	• Second order response: under and over-damped. • Observations on the effect of resistance and capacitance to the second order response.	• Perform, observe, and record the time contant and the natural frequency which may appear in a second order circuits • Observe the effect of resistance and capacitance to the second order response	Lab Manual and Class Hand-outs
11	• AC and RC and RL circuits	• Impedance dan voltage phasor observation in RC and RL ac circuits • RC circuit as integrator and differentiator • RC circuits as LPF and HPF	• Learn about AC signals and the concept of phasor and impedance. • Observe and understand the behavior of RC and RL circuits as LPF and HPF and as integrator and differentiator.	Lab Manual and Class Hand-outs
12	• AC and RC and RL circuits	• Effect of the signal frequency and time circuit constant on RC response • Sketching Bode Plot from measurement	• Observe and understand the effect of the signal frequency and time circuit constant on RC circuit response • Understand and sketch the Bode plot of a signal transfer ratio from measurement	Lab Manual and Class Hand-outs
13	• Resonance circuits	• Series and shunt resonance observation • Observation and reading of quality factor of series resonance	• Design and understand RLC circuits, both parallel and series. • Construct, observe and record the series and shut resonance phenomena in RLC circuits • Show the resonance frequency of series and shunt resonances • Measure the quality factor of series resonance	Lab Manual and Class Hand-outs

14	• Resonance circuits	• Curcuits with series and shunt resonance: frequency response prediction and observation • Use of resonance circuit as bandpass and bandstop filters	• Construct, predict, observe, and record the series and shut resonance of multiple L and C circuits • Apply resonance circuit in bandpass and bandstop filter design.	Lab Manual and Class Hand-outs
15	• Review 2	•	•	

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2102	***Bobot sks:*** 1	***Semester:*** 3	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Praktikum Sistem Digital			
	Digital System Laboratory			
Silabus Ringkas	Pengamatan dan penentuan karakteristik teknologi implementasi sistem digital. Implementasi pada FPGA. Perancangan sistem kombinasional, sistem sekuensial, dan perancangan kontroler/aplikasi dengan tingkat kompleksitas sedang.			
	Characteristization of the implementation technology of a digital system. Implementation of a digital system on FPGA. Design of combinational and sequential circuit. Design of controller/digital system with intermediate complexity.			
Silabus Lengkap	Mata kuliah ini adalah praktikum untuk mata kuliah sistem digital. Dalam mata kuliah ini, mahasiswa mengukur dan mengamati karakteristik dari teknologi implementasi dari suatu gerbang logika (VTC, fan-in, fan out, dll). Mahasiswa juga belajar mengimplementasikan suatu sistem digital dengan FPGA. Sistem yang harus dirancang oleh mahasiswa: sistem kombinasional, sekuensial. Pada praktikum terakhir mahasiswa merancang suatu aplikasi/kontroler dengan kompleksitas sedang/menengah. Artinya design tersebut harus meliputi bagian sekuensial, bagian kombinasional, dan terhubung dangan sistem/peripheral yang sudah ada seperti monitor VGA, sound card,dll. Namun belum perlu menggunakan konsep/blok yang lanjut seperti processor, memory, bus kompleks, dll.			
	This course is a laboratory course for digital systems. In this course, students measure and observe characteristics of the implementation technology of a digital gates: VTC, fan in, fan out, etc. The student learns to use FPGA as implementation of a digital system. In the laboratory work, the student must design a combinational and sequential logic. In the last experiment, the student must design a digital controller/application with intermediate complexity: a system with combinational, sequential part combined with existing peripheral such as VGA monitor, sound card, etc. It is not required for the student to use complex building block such as processor or memory and memory controller.			
Luaran (Outcomes)	38. Measure various characteristics of logic gate: VTC, fan in,etc. 39. Able to chose a digital logic implementation based on characteristics and logic functions 40. Able to use FPGA using schematics, and VHDL entryo 41. Write VHDL code for simulation, synthesis, and test bench 42. Design a combinational circuit and implement it on FPGA 43. Design a sequential circuit and implement it on FPGA 44. Design a digital system with intermediate complexity 45. Able to create interface for existing digital system (VGA)			
Matakuliah Terkait	EL2002 Sistem Digital		Bersamaan	
Kegiatan Penunjang				
Pustaka				
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Introduction	• Classroom and Lab Rules and Regulation • Laboratory Note Book • Lab Safety	• Connect the lab rulesand regulations to the lab activities • Write important information before, during and after the lab activities • Cite lab safety while in labs • Learn how to write a proper lab report (both content and presentation).	Lab Manual and Class Hand-outs
2	• Logic Gate parameter	• Characteristic of logic gate • Operating point of logic gate • Combinational logic using CMOS	• Knowing charactheristic of logic gate, noise margin and propagation delay • Understand operating point of logic range • Able to create simple combinational logic using CMOS	Lab Manual and Class Hand-outs
3	• Design using FPGA	• Design using schematic diagram • Design using VHDL • Simulation • Synthesis • Testbench	• Learning a design method using FPGA as target • Able to use tool/software for synthesis and simulation	Lab Manual and Class Hand-outs
4	• Combinational logic circuit	• Simple logic circuit • Abstraction in digital system	• Able to design simple circuit • Design BCD-to-7-segment • Using functional simulation to verify logic function • Able to analyse worst case delay using simulation • Measure propagation delay • Undesrstand abstraction level in digital system	Lab Manual and Class Hand-outs
5	• Sequential logic circuit	• FSM • Sequential logic on VHDL	• Design and implement sequential circuit using FPGA • Understand design hierarchy • Understand of using FPGA as prototype system for verifying a circuit	Lab Manual and Class Hand-outs
6	• Design and implementation LCD display using VGA modul on FPGA	• VGA • Controller	• Able to use peripheral on FPGA board • Understand how FPGA work	Lab Manual and Class Hand-outs
7	• Design Project	• Specification • Data path and control path • Testing • Interfacing	• Able to specify a digital system • Separate data and control • Designing datapath • Designing Control path • Integrating data and control • Implementing a digital system with intermediate complexity on FPGA • Testing a digital system	Lab Manual and Class Hand-outs

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3215	***Bobot sks:*** 3	***Semester:*** 6	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Praktikum Sistem Kendali			
	Control System Laboratory			
Silabus Ringkas	Mahasiswa melakukan praktek realisasi sistem kendali baik posisi maupun kecepatan pada pada sebuah motor DC dengan perangkat modular analog/digital yang tersedia. Praktikum ini fokus pada sistem kendali analog dengan pengenalan pada sistem kendali digital sederhana. Mahasiswa melakukan proses identifikasi motor DC, melakukan simulasi sistem kendali analog dan digital sederhana, merancang dan merealisasikan pengendali PID , merealisasikan sistem kendali posisi/kecepatan, kemudian membandingkan antara hasil perhitungan, simulasi, dan pengukuran langsung.			
Silabus Lengkap	Mahasiswa melakukan praktek realisasi sistem kendali baik posisi maupun kecepatan pada pada sebuah motor DC dengan perangkat modular analog/digital yang tersedia. Praktikum ini fokus pada sistem kendali analog dengan pengenalan pada sistem kendali digital sederhana. Mahasiswa melakukan proses identifikasi motor DC, melakukan simulasi sistem kendali analog dan digital sederhana, merancang dan merealisasikan pengendali PID , merealisasikan sistem kendali posisi/kecepatan, kemudian membandingkan antara hasil perhitungan, simulasi, dan pengukuran langsung.			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	Mahasiswa mampu merangkai dan mengukur kinerja sistem kendali analog dengan alat ukur Mahassiwa mampu mengaapresiasi perbedaan dan kemiripan antara teori, simulasi, dan realisasi sistem kendali Mahasiswa mampu merangkai dan mengukur kinerja sistem kendali digital sederhana dengan alat ukur Mahasiswa mampu menggunakan MATLAB dan Simulink untuk validasi perhitungan/rancangan sistem kendali PID analog maupun digital sederhana			
Matakuliah Terkait	EL3015 Sistem Kendali		Bersamaan	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang				
Pustaka	Lab Manual			
	MATLAB Guide			
	SIMULINK Guide			
Panduan Penilaian	Lab reports 100%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pengenalan perangkat MS-150 dan alat ukur	[*Uraikan sub-topik bahasan*]	• Mengenal kegunaan dan karakteristik alat-alat praktikum MS-150 • Mampu mengoperasikan motor dengan kontroller yang ada.	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Pengukuran fungsi alih dan Pengenalan MATLAB		• Mampu melakukan pengukuran fungsi transfer secara sederhana, dengan kasus motor arus searah pengaturan jangkar. • Mampu menggunakan fungsi/perintah dasar terkait sistem kendali pada MATLAB • Mampu menggunakan SIMULINK untuk simulasi sistem kendali	
3	Sistem Kendali Kecepatan Motor dengan Kendali PID		• Memahami kelebihan dan kekurangan sistem kontrol lingkar tertutup dibandingkan sistem kontrol terbuka. • Mampu melakukan analisa kinerja suatu sistem kontrol. • Mengetahui pengaruh kontroler proporsional, kontroler integral, kontroler derivatif pada sistem kontrol. • Memahami sistem kontrol kecepatan sederhana	
4	Sistem Kendali Posisi Sudut Motor dengan Kendali PID		• Mampu melakukan analisis kinerja sistem pengaturan posisi motor arus searah. • Mampu menerangkan pengaruh kecepatan pada kinerja suatu sistem pengaturan posisi. • Mampu menerangkan pengaruh kontroler PD pada kinerja sistem pengaturan posisi.	
5	Simulasi Sistem Kendali Analog dan Digital dengan MATLAB dan SIMULINK		• Mampu menggunakan MATLAB dan SIMULINK untuk simulasi sistem kendali analog maupun digital	
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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3216	***Bobot sks:*** 1	***Semester:*** 6	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Praktikum Sistem Komunikasi			
	Commuication Systems Lab			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	It is a companion lab to EL3016. It covers: fundamental elements of communications systems and the hardware usually used: use of measurement instruments typically encountered in communication systems; analog modulation AM/FM; various modulations and channel coding for digital communications; digital baseband pulse transmission; digital bandpass transmission.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	It is a companion lab to EL3016. It covers: fundamental elements of communications systems and the hardware usually used: use of measurement instruments typically encountered in communication systems; analog modulation AM/FM; various modulations and channel coding for digital communications; digital baseband pulse transmission; digital bandpass transmission.			
Luaran (Outcomes)				
Matakuliah Terkait	EL3016 Sistem Komunikasi		Prerequisite	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Lab reports 100%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1		[*Uraikan sub-topik bahasan*]	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
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Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3214	***Bobot sks:*** 3	***Semester:*** 6	***KK / Unit Penanggung Jawab:*** Prodi Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Praktikum Sistem Mikroprosesor			
	Microprocessor System Laboratory			
Silabus Ringkas	Menggunakan toolchain untuk pemrograman mikrokontroler 8 bit. Bus mikroprosesor 8 bit. Antar muka digital. Antar muka analog. Komunikasi serial. Display LCD. Menggunakan toolchain untuk pemrograman mikrokontroler 8 bit . Input output digital mikrokontroler 32 bit. Menggunakan sistem operasi untuk mikrokontroler 32 bit. Membuat aplikasi 32 bit sederhana.			
Silabus Lengkap	Menggunakan toolchain untuk pemrograman mikrokontroler 8 bit. Mengukur dan menganalisa sinyal pada bus mikroprosesor 8 bit. Antar muka digital meliputi input (sakelar dan keypad) dan output (LED tunggal, LED matrix, 7 segment, shift register). Antar muka analog (ADC dan PWM sebagai DAC). Komunikasi serial asinkron. Display LCD. Menggunakan toolchain untuk pemrograman mikrokontroler 8 bit . Input output digital mikrokontroler 32 bit. Menggunakan sistem operasi untuk mikrokontroler 32 bit. Membuat aplikasi 32 bit sederhana. Komunikasi serial CAN.			
Luaran (Outcomes)	46. Mampu menggunakan toolchain untuk memprogram mikrokontroler 8 bit 47. Menggunakan sakelar sebagai input digital 48. Menggunakan LED tunggal, LED Matrix dan LED 7 segmen sebagai output digital pada mikrokontroler 8 bit 49. Menggunakan ADC sebagai input analog 50. Menggunakan PWM sebagai output analog 51. Menggunakan toolchain untuk memprogram mikrokontroler 32 bit 52. Menguasai Input output digital pada mikrokontroler 32 bit 53. Menganalisa sinyal pada bus sistem mikroprosesor 8 bit 54. Menggunakan sistem operasi 32 bit untuk mikrokontroler 55. Membuat aplikasi sederhana berbasis sistem operasi pada mikrokontroler 32 bit			
Matakuliah Terkait	EL2205 Praktikum Elektronika	Prasyarat		
	EL2208 Prakt. Pemecahan Masalah dgn C	Prasyarat		
	EL3014 Sistem Mikroprosesor	Bersamaan		
Kegiatan Penunjang				
Pustaka				
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)			
Catatan Tambahan				

Mg#	***Topik***	***Sub Topik***	***Capaian Belajar Mahasiswa***	***Sumber Materi***
1	• Introduction	• Classroom and Lab Rules and Regulation • Laboratory Note Book • Lab Safety	• Connect the lab rules and regulations to the lab activities • Write important information before, during and after the lab activities • Cite lab safety while in labs • Learn how to write a proper lab report (both content and presentation).	Lab Manual and Class Hand-outs
2	• Toolchain 8 bit	• Compiler	• Compile and upload program	
3	• Microprocessor Bus		• Mengukur sinyal pada bus sistem mikroprosesor dengan logic analyzer • Interpretasi sinyal yang diukur • Mencocokkan sinyal yang diukur dengan teori dari datasheet	
4	• Digital Input		• Membuat software untuk membaca kondisi sakelar dan input digital lainnya • Mencoba software digital input dengan interupsi	
5	• Digital Output Sederhana		• Membuat software untuk mengendalikan LED tunggal, shift	

			register	
	• Digital Output Kompleks		• Mencoba software dan hardware untuk menjalankan LED matrix dan 7 segment dengan metode scanning berbasis interupsi	
6	• Analog Input		• Membuat software untuk mengukur tegangan analog melalui ADC	
7	• Analog Output		• Membuat software dan hardware untuk menghasilkan sinyal analog melalui PWM • Mengukur sinyal analog yang dihasilkan	
8	• Derau		• Mengukur derau pada rangkaian sistem mikroprosesor • Mengukur pengaruh teknik reduksi derah pada sistem mikroprosesor	
9	• Komunikasi		• Komunikasi serial asinkron • Komunikasi serial SPI • Komunikasi serial CAN bus	
10	Toolchain 32 bit		• Compile and upload program • Menjalankan Digital input output sederhana pada prosesor ARM 32 bit	
11	Sistem Operasi		• Menjalankan sistem operasi pada prosesor ARM 32 bit • Membuat aplikasi sederhana berbasis sistem operasi ARM 32 bit	

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3217	***Bobot sks:*** 1	***Semester:*** 6	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Praktikum Sistem Tenaga Elektrik			
	Power Systems Laboratory			
Silabus Ringkas	Penggunaan modern engineering tools (MATLAB dll) untuk melakukan analisa jejaring sistem tenaga mengenai kestabilan, aliran dan transmisi daya, parameter transmisi, harmonik, kualitas daya.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	Mahasiswa mampu menggunakan modern engineering tools (MATLAB dll) untuk melakukan analisa jejaring sistem tenaga mengenai kestabilan, aliran dan transmisi daya, parameter transmisi, harmonik, kualitas daya, dll			
Matakuliah Terkait	EL3017 Sistem Tenaga Elektrik		Bersamaan	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Lab reports 100%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Aliran dan Transmisi Daya	[*Uraikan sub-topik bahasan*]	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Parameter Transmisi			
3	Kestabilan dan Transien			
4	Analisa Harmonik			
5	Analisa Kualitas Daya			
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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2004	***Bobot sks:*** ***3***	***Semester:*** ***3***	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Probabilitas dan Statistik			
	Probability and Statistics			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	The concept of probability, random variables and their distributions, combinatorial and geometric elements, conditional probability, Bayes theorem, distribution functions, bivirate random variables, functions of random variables, estimation, hypothesis testing. Applications may be from digital communications, signal processing, automatic control, computer engineering, computer science.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
Luaran (Outcomes)	Achieving knowlege and understanding of probability, random variables and their distributions, combinatorial and geometric elements, conditional probability, Bayes theorem, distribution functions, bivirate random variables, functions of random variables, estimation, hypothesis testing.			
Matakuliah Terkait	MA1201 - Matematika IIA		Prasyarat	
Kegiatan Penunjang				
Pustaka	Douglas C. Montgomery; George C. Runger, Applied Statistics and Probability for Engineers, 5th Edition, John Wiley, 2010			
	Walpole and Myers, Probability and Statistics for Engineer and Scientist			
	Probability and Statistics for Engineers and Scientists, 4th ed., by Anthony Hayter			
	The Probability Tutoring Book, Carol Ash, IEEE Press			
Panduan Penilaian	Homework 20% Exam 70% Quiz 10%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Probability Concepts	Probabilities, Events, Union, Intersection, Conditional Probability, Bayes' Theorem, Counting Techniques		
2	Combinational Elements & Geometric Probability			
3	Conditional Probability, Bayes Theorem and Independence			
4	Distribution Functions			
5	Random Variables	Discrete and Continuous Distributions, Expectation, Variance, Combinations and Functions, Joint Distributions, Correlation, Covariance		
6	Bivariate Random Variables			
7	Function of Random Variables	Functions of one random variable, Functions of more than one, one random variable, The Characteristic Function (Moment generating function)		
8	Discrete Probability Distributions	Binomial, Geometric, Negative Binomial, Hypergeometric and Poisson Distributions		
9	Continuous Probability Distributions	Uniform, Exponential, Gamma and Weibull Distributions		
10	Normal Distribution	Probability Calculations, Linear Combinations, Normal Approximation to Binomial Distribution, Central Limit Theorem		
11	Descriptive Statistics	Data Presentation, Charts, Histograms, Sample Statistics, Mean, Median, Variance, Coefficient of Variation, Outliers, Percentiles		
12	Statistical Estimation and Sampling Distributions	Point Estimates and their Properties, Sampling Distributions, Construction Parameter Estimates		
13	Inferences on a Population Mean	Confidence Intervals, Hypothesis Testing (Variance known/unknown)		
14	Comparing Two Population Means	Two Independent Samples Confidence Intervals and Hypothesis Testing, Paired Samples		
15	Simple Linear Regression and Correlation	Regression, Inferences on the Slope Parameter, Prediction Intervals, Coefficient of Determination, Residual Analysis, Correlation Analysis		

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Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK/Unit PenanggungJawab:*	*Sifat:*
EL2001	4	3	Prodi S1 Teknik Elektro	Wajib

Nama Matakuliah	Rangkaian Elektrik
	Electric Circuits
Silabus Ringkas	
	Sinusoidal steady-state analysis, AC power analysis, three-phase circuits, magnetically coupled-circuits, frequency response, Laplace transform and its application to circuit analysis, Fourrier series, Fourrier Transform, two-port networks.
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]
	Sinusoidal steady-state analysis: review of phasor concepts, circuit analysis and theorems. AC power analysis: Instantaneous & Average Power, Maximum Average Power Transfer, Effective or RMS value, Apparent Power & Power Factor, Complex Power, Conservation of AC Power and Power factor correction. Three-phase circuits: balanced & unbalanced delta-delta, delta-wye, wye-delta, and wye-wye connections. Power measurement using wattmeters. Magnetically coupled-circuits: Mutual inductances and its energy, linear & ideal auto-transformers. Frequency response: transfer function, Bode plot, series & parallel resonance, active & passive filters and its scaling factor. Laplace transform and its application to circuit analysis: Laplace Transform and its inverse. Analysis of circuits using Laplace transform. Representation of state space for RLC circuits. Fourrier series: Trigonometric and exponential Fourier series, symmetry considerations, circuit applications and average power & RMS values. Fourrier Transform: definition, Properties, circuit applications, Parseval Theorem, comparing the Fourier & Laplace Transforms. Two-port networks: Impedance, Admittance, hybrid, and transmission Parameters, conversion between parameters, interconnection of networks.
Luaran (Outcomes)	At the end of this subject, students should be able to: 1. Apply phasor frequency domain analysis using various techniques. 2. Apply phasor concept to analyse AC power and three-phase circuits. 3. Deal with circuits containing magnetically coupled. 4. Draw Bode plot of transfer function and use frequency domain to analyse resonance and filter networks. 5. Apply Laplace transform to analyse DC and AC steady state networks. 6. Apply Fourier series and Fourier transformation to analyse the networks with non sinusoidal exitation. 7. Analyse 2-port networks using various parameters. 8. Use SPICE to analyst DC and AC circuits. 9. Use Matlab as a tool to solve the network problems.
Matakuliah Terkait	EL1200 Pengantar Analisis Rangkaian — Prasyarat
	EL2101 Praktikum Rangk.Elektrik — Bersamaan
Kegiatan Penunjang	Penggunaan Tools (MA TLAB dan SPICE)
Pustaka	C.K. Alexander & M.N.O. Sadiku, Fundamentals of Electric Circuits, Mc Graw Hill, Fifth Edition, 2013 [Pustaka Utama]
	L. O. Chua, C. A. Desoer, and E. S. Kuh, **Linear and NonLinear Circuits,** McGraw-Hill Interational Editions, 1987.
Panduan Penilaian	*Bobot penilaian: PR 15%, Kuis 15%, UTS 35%, UAS 35%*
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction to Circuit Analysis.	Nodes, branches, loops, Directed graphs. Kirchhoff's laws and cut sets Lumped of Circuit's element. Circuit graph. Tableau Analysis. Extended Nodal Analysis. Applications. Tellegen's theorem. Applications. Reciprocal and Millman Theorem.	Understand the condition fulfilled for lumped circuits. Apply Tableau & extended nodal analysis techniques to analyze circuit behavior.	Chua: Chapter 1
2	Sinusoidal Steady-state Analysis	Review of phasor concept. Nodal Analysis. Mesh Analysis. Superposition Theorem. Source Transformation. Thevenin & Norton Equivalent Circuits. Op Amp AC Circuits. Applications.	Convert problems involving differential equations into circuit analysis problems using phasors and complex impedances.	*Alexander & Sadiku: Chapter 10*
3	AC Power Analysis	Instantaneous & Average Power. Maximum Average Power Transfer. Effective or RMS value. Apparent Power & Power Factor. Complex Power. Conservation of AC Power. Power factor correction. Applications.	Analyze RLC circuits under sinusoidal steady state conditions. Analyze complex power and its relationship to real and reactive power using complex phasor notation.	*Alexander & Sadiku: Chapter 11*
4	Three-phase Circuits	Balanced Three-phase voltages. Balances Wye-Wye Connection. Balances Wye-Delta Connection. Balances Delta-Wye Connection. Balances Delta-Delta Connection.	Analyse balanced three-phase system in AC steady state.	*Alexander & Sadiku: Chapter12: 12.1 – 6*
5	Three-phase Circuits	Power in balanced system. Unbalances three-phase systems. Applications.	Calculate power in balanced system. Analyse unbalanced three-phase system in AC steady state.	*Alexander & Sadiku: Chapter12.7 – 12.9*
6	Magnetically Coupled Circuits	Mutual inductances. Energy in a coupled circuits. Linear transformers. Ideal Transformer. Ideal Autotransformer. 3-phase transformer. Applications.	Understand the concept of mutual inductance and how it affects circuit performance and its use in transformers. Analyze circuits involving mutual inductance or transformers using phasor techniques.	*Alexander & Sadiku: Chapter 13*
7	Frequency Response	Transfer function. Bode Plot. Series & Paralel resonances	Plot the frequency response of RLC circuits using Bode. Interpret the Bode plot in order to get its transfer function.	*Alexander & Sadiku: Chapter 14: 14.1 – 14.6*
8	Frequency Response	Passive and active	Design simple filter using	*Alexander & Sadiku: Chapter*

		Filters. Scaling. Frequency response using SPICE. Applications	scaling technique.	*14: 14.7 – 14.12*
9	Introduction to Laplace Transform	Definition of Laplace Transform. Properties of Laplace transform. Inverse Laplace Transform. Convolution Integral. Applications.	Understand Laplace Transform, its properties and its inverse in order to solve the differential equations.	*Alexander & Sadiku: Chapter 15*
10	Applications of Laplace Transform	Circuit element models. Circuit analysis. Transfer functions.	Solve and analyze RLC circuits under both transient and steady state conditions using Laplace transform techniques.	*Alexander & Sadiku: Chapter 16: 16.1 – 16.4*
11	Applications of Laplace Transform	State variables. Applications.	Describe RLC circuits using state space concept and then solve it using Laplace transform techniques.	*Alexander & Sadiku: Chapter 16: 16.5 – 16.6*
12	The Fourrier Series	Trigonometric Fourier series. Symmetry considerations. Circuit applications. Average power & RMS values. Exponential Fourier series. Applications.	Analyse any periodic waveforms into its DC and ac components. Analyse the circuits with any periodic waveforms excitation. Analyse any periodic waveforms into its DC and ac components. Analyse the circuits with any periodic waveforms excitation.	*Alexander & Sadiku: Chapter 17*
13	The Fourier Transform	Definition, Properties, circuit applications, Parseval Theorem, comparing the Fourier & Laplace Transforms, Applications.	Apply Fourier Transform to analysis circuits.	*Alexander & Sadiku: Chapter 18*
14	Two-port Networks	Impedance, Admittance, hybrid, and transmission Parameters.	Model an electric circuit as an electrical network with two separate ports, i.e. input and output ports.	*Alexander & Sadiku: Chapter 19: 19.1 – 19.5*
15	Two-port Networks	Relationship between parameters. Interconnection of networks. Applications	Find parameters of 6 types of two port networks (impedance, admittance, hybrid, inverse hybrid, transmission, inverse transmission)	*Alexander & Sadiku: Chapter 19: 19.6 – 19.9*

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Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL2007	**3**	**4**	Prodi S1 Teknik Elektro	Wajib

Nama Matakuliah	Sinyal dan Sistem
	Signal and System
Silabus Ringkas	
	Introduction; Mathematical Description of Signals (Continuous); Mathematical Description of Signals (Discrete); Description of System; Time Domain Analysis; Fourier Series; Circuit Analysis with Fourier Series; Fourier Transform; Laplace Transform; Analysis with Laplace Transform; Frequency Response Analysis; Sampling and Signal Processing; The Z Transform; State Space representation or Examples of application
Silabus Lengkap	
	Introduction : Signals and System Defined, Types of Signals, Examples of Systems, Familiar Signals and Systems Examples; Mathematical Description of Continuous Signals : Periodicity, Amplitude Scaling, Time Shifting, Time Scaling, Combination of operation,Even and Odd Signals, Derivative and Integral, Signal Energy and Power, Complex Sinusoid; Mathematical Description of Discrete Signals : Periodicity, Amplitude Scaling, Time Shifting, Time Scaling, Combination of operation,Even and Odd Signals, Derivative and Integral, Signal Energy and Power; Description of System : Cont Time System (System modelling, properties, dynamics of 2nd order system), Discrete Time System, Complex Sinusoid Exitation Time Domain Analysis : Impulse respons for continuous system,Impulse response for discrete time system, discrete time convolution,continuous time convolution, system property from impulse response; Fourier Series : Conceptual basis, trigonometric fourier series, Fourier series of even and odd function, complex form of Fourier Series; Circuit Analysis with Fourier Series; Circuit analysis with Phasor Fourier Transform : Extending Fourier Series to aperiodic signal, properties of Fourier Transform, Analysis Examples; Laplace Transform : Development of Laplace transform from Fourier Transform, Properties of Laplace Transform, Inverse Laplace Transform, Partial Fraction Expansion, Transfer Function; Analysis with Laplace Transform Analysis Examples, Pole Zero Map, RoC, Matlab Examples; Frequency Response Analysis : Introduction to Frequency Response, Bode Diagram, How to draw Bode Diagram; Sampling and Signal Processing : Sampling method, sampling theorem, aliasing, anti aliasing filter; The Z Transform : Generalizing Discrete Time Fourier Transform, Properties of Z Transform, Inverser Z Tansform, Bilinear Transform, RoC; State Space representation or Examples of application : State space concept, State space solution, FFT in image / video compression
Luaran (Outcomes)	Knows the importance of signals and systems, excitation, response Knows how to describe continuous signals in mathematic equation Knows how to describe discrete signals in mathematic equation Knows how to describe system in mathematic equation Knows how to do time domain analysis using impulse response and convolution Knows the concept about decompose signal by its frequency propery, knows how to calculate fourier series of signals Knows how to do circuit analysis with Fourier Series Knows about Fourier Transform, and its limitation, knows how to do analysis with Fourier Transform Knows about Fourier Transform, its properties, Transfer Function, and PFE Knows how to do analysis with Laplace Transform and system properties from transfer function Knows how to make Bode Diagram, and use it to quickly understand about system characteristic Knows about sampling, sampling theorem, aliasing, and anti aliasing filter Introduced to Z Transform Introduced to state space representation and examples of signals and system application
Matakuliah Terkait	MA2074 Matematika Teknik II – Bersamaan
Kegiatan Penunjang	
Pustaka	M.J. Robert, Signals and Systems: Analysis of Signals Through Linear Systems, McGraw-Hill Science/Engineering/Math; 1 edition, June 18, 2003 (Pustaka Utama)
	M.J. Roberts, Signals and Systems: Analysis Using Transform Methods & MATLAB Second, McGraw-Hill Science/Engineering/Math, Mar 17, 2011 (Pustaka Pendukung)
	Steven T. Karris, Signals and Systems with MATLAB Computing and Simulink Modeling, Fifth Edition, Orchard Publications, March 19, 2012 (Pustaka Pendukung)
Panduan Penilaian	UTS : 40%, UAS : 40%, Tugas (PR dan Kuis) : 20%
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction	Signals and System Defined, Types of Signals, Examples of Systems, Familiar Signals and Systems Examples	*Knows the importance of signals and systems, excitation, response*	Chapter 1 Pustaka Utama
2	*Mathematical Description of Signals (Continuous)*	*Periodicity, Amplitude Scaling, Time Shifting, Time Scaling, Combination of operation,Even and Odd Signals, Derivative and Integral, Signal Energy and Power, Complex Sinusoid*	*Knows how to describe continuous signals in mathematic equation*	Chapter 2 Pustaka Utama
3	*Mathematical Description of Signals (Discrete)*	*Periodicity, Amplitude Scaling, Time Shifting, Time Scaling, Combination of operation,Even and Odd Signals, Derivative and Integral, Signal Energy and Power*	*Knows how to describe discrete signals in mathematic equation*	Chapter 3 Pustaka Utama
4	*Description of System*	*Cont Time System (System modelling, properties, dynamics of 2nd order system), Discrete Time System, Complex Sinusoid Exitation*	*Knows how to describe system in mathematic equation*	Chapter 4 Pustaka Utama
5	*Time Domain Analysis*	*Impulse respons for continuous system,Impulse response for discrete time system, discrete time convolution,continuous time convolution, system property from impulse response*	*Knows how to do time domain analysis using impulse response and convolution*	Chapter 5 Pustaka Utama
6	*Fourier Series*	*Conceptual basis, trigonometric fourier series, Fourier series of even and odd function, complex form of Fourier Series*	*Knows the concept about decompose signal by its frequency propery, knows how to calculate fourier series of signals*	Chapter 6 Pustaka Utama
7	*Circuit Analysis with Fourier Series*	*Circuit analysis with Phasor*	*Knows how to do circuit analysis with Fourier Series*	*Examples*
8	*UTS*			
9	*Fourier Transform*	*Extending Fourier Series to aperiodic signal, properties of Fourier Transform, Analysis Examples*	*Knows about Fourier Transform, and its limitation, knows how to do analysis with Fourier Transform*	Chapter 7 Pustaka Utama
10	*Laplace Transform*	*Development of Laplace transform from Fourier Transform, Properties of Laplace Transform, Inverse Laplace Transform, Partial Fraction Expansion, Transfer Function*	*Knows about Fourier Transform, its properties, Transfer Function, and PFE*	Chapter 8 Pustaka Utama
11	*Analysis with Laplace Transform*	*Analysis Examples, Pole Zero Map, RoC, Matlab Examples*	*Knows how to do analysis with Laplace Transform and system properties from transfer function*	Chapter 8 Pustaka Utama
12	*Frequency Response Analysis*	*Introduction to Frequency Response, Bode Diagram, How to draw Bode Diagram*	*Knows how to make Bode Diagram, and use it to quickly understand about system characteristic*	Chapter 11 Pustaka Utama
13	*Sampling and Signal Processing*	*Sampling method, sampling theorem, aliasing, anti aliasing filter*	*Knows about sampling, sampling theorem, aliasing, and anti aliasing filter*	Chapter 10 Pustaka Utama
14	*The Z Transform*	*Generalizing Discrete Time Fourier Transform, Properties of Z Transform, Inverser Z Tansform, Bilinear Transform, RoC*	*Introduced to Z Transform*	Chapter 9 Pustaka Utama
15	*State Space representation or Examples of application*	*State space concept, State space solution, FFT in image / video compression*	*Introduced to state space representation and examples of signals and system application*	Chapter 16 Pustaka Utama , *External source*
16	*UAS*			

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*Unit Penanggung Jawab:*	*Sifat:*
EL2002	**3**	3	Prodi S1 Teknik Elektro	Wajib

Nama Matakuliah	Sistem Digital
	Digital System
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]
	Fundamentals of digital logic design. Covers combinational and sequential logic circuits, programmable logic devices, hardware description languages, and computer-aided design (CAD) tools. Laboratory component introduces simulation and synthesis software and hands-on hardware design
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]
	The following topics will be covered: 1. Digital systems: digital computers and digital systems; binary, octal and hexadecimal number systems; complements; signed binary numbers; decimal and binary codes; introduction to binary logic 2. Boolean algebra: basic definitions, theorems and properties of Boolean algebra; Boolean functions;standard forms of Boolean functions; logic operations 3. Simplification of Boolean functions: Karnaugh map method; don't care condition; NAND and NOR 4. implementation; KMAP_MEV; Quine-McCluskey 5. Combinational circuits: analysis and design procedures; adders, subtractors, multilevel NAND/NOR circuits and code conversion; transistor switches and practical design considerations 6. MSI and PLD devices: magnitude comparators, decoders, encoders, multiplexers, read-only memory (ROM), Programmable Logic Array (PLA), and Programmable Array Logic (PAL) 7. Analysis of synchronous sequential circuits: flip-flops; analysis of clocked sequential circuits; statereduction and assignment 8. Design of sequential circuits: flip-flop excita tion tables, design procedures, counter designs 9. Analysis and design of Asynchronous sequential circuit: fundamental mode; pulse mode; race; hazard; incompletey specified machine; state assigment; state reduction 10. Registers, counters and memory devices: shift registers, ripple counters, synchronous counters, timing 11. sequences, and Random Access Memory (RAM)
Luaran (Outcomes)	1. Be able to represent and manipulate numbers in the binary two's complement number system, and convert numbers between different positional number systems. Be able to do negation and addition in the two's complement number system, and detect overflow. 2. Carry out transformations of Boolean algebra expressions, using the theorems of Boolean algebra and Karnaugh maps. The student can find the minimal sum-of-products (SOP) and product-of-sums (POS) expressions, and create a corresponding circuit from AND, OR, NAND, and NOR gates. 3. The student will be able to analyze the functional and electrical behavior of digital CMOS circuits, including noise margins, allowable fan-in/out, and power dissipation. Given an NMOS or CMOS circuit diagram, the student can determine its logic function, using switch models for the transistors. The student can map simple functions onto programmable logic devices manually. 4. The student can analyze and design digital systems of moderate complexity using contemporary technology methods, including programmable logic devices and CAD tools. The student can use standard combinational and sequential digital building blocks including adders, multiplexers, decoders, encoders, and registers. 5. The student can analyze and design both synchronous and asynchronous state machines. 6. The student will be able to write proper lab reports, communicating their objectives, approach, observations, and conclusions
Matakuliah Terkait	EL1200 Introduction to Circuit Analysis — Prasyarat
	EL2003 Struktur Diskrit — Bersamaan
	EL2102 Digital System Laboratory — Bersamaan
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]
Pustaka	S. Brown and Z. Vranesic: Fundamentals of Digital Logic and VHDL Design, 3rd Edition McGraw-Hill, 2009
	Donald D. Givone, Digital Principles and Design, McGraw-Hill, 2002
	J. M. Yarborough, Digital Logic Application and Design, West Publishing Co, St. Paul, 1997
	V. P. Nelson, H. T. Nagle, B. D. Carroll, and D. Irwin, Digital Logic Circuit Analysis and Design, Prentice Hall, Englewood Cliffs, 1995
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction		1. Identify some contributors to digital logic and relate their achievements to the knowledge area. 2. Explain why Boolen logic is important to this subject. 3. Articulate why gates are the fundamental elements of a digital system. 4. Describe how electrical engineering uses or benefits from digital logic.	(S. Brown and Z. Vranesic) Chapter 1
	Boolean Algebra + Logic Circuit		1. Derive and manipulate switching functions that form the basis of digital circuits. 2. Apply digital system design principles and techniques. 3. Model and simulate a digital system using schematic diagrams. 4. Model and simulate a digital system using a hardware description language, such as VHDL or Verilog. 5. Understand timing issues in digital systems and know how to study these via digital circuit simulation.	(S. Brown and Z. Vranesic) Chapter 2
2	Boolean Algebra + Logic Circuit		1. Derive and manipulate switching functions that form the basis of digital circuits. 2. Apply digital system design principles and techniques. 3. Model and simulate a digital system using schematic diagrams. 4. Model and simulate a digital system using a hardware description language, such as VHDL or Verilog. 5. Understand timing issues in digital systems and know how to study these via digital circuit simulation.	(S. Brown and Z. Vranesic) Chapter 2
	Implementation Technology		1. Realize switching functions with networks of logic gates. 2. Explain and apply fundamental characteristics of relevant electronic technologies, such as propagation delay, fan-in, fan-out, and power dissipation and noise margin. 3. Utilize programmable devices such as FPGAs and PLDs to implement digital system designs.	(S. Brown and Z. Vranesic) Chapter 3
3	Implementation Technology		1. Realize switching functions with networks of logic gates. 2. Explain and apply fundamental characteristics of relevant electronic technologies, such as propagation delay, fan-in, fan-out, and power dissipation and noise margin. 3. Utilize programmable devices such as FPGAs and PLDs to implement digital system designs.	(S. Brown and Z. Vranesic) Chapter 3
	Optimized Implementation of Logic Functions - KMAP		1. Derive and manipulate switching functions that form the basis of digital circuits. 2. Reduce switching functions to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 4
4	Optimized		1. Derive and manipulate	(S. Brown and Z. Vranesic)

	Implementation of Logic Functions - KMAP		switching functions that form the basis of digital circuits. 2. Reduce switching functions to simplify circuits used to realize them.	Chapter 4
	Optimized Implementation of Logic Functions - MEV		1. Derive and manipulate switching functions that form the basis of digital circuits. 2. Reduce switching functions to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 4
5	Optimized Implementation of Logic Functions - MEV		1. Derive and manipulate switching functions that form the basis of digital circuits. 2. Reduce switching functions to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 4
	Optimized Implementation of Logic Functions - Quine McCluskey		1. Derive and manipulate switching functions that form the basis of digital circuits. 2. Reduce switching functions to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 4
6	Optimized Implementation of Logic Functions - Quine McCluskey		1. Derive and manipulate switching functions that form the basis of digital circuits. 2. Reduce switching functions to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 4
7	Number Representation & Arithmetic Circuit		1. Work with binary number systems and arithmetic.	(S. Brown and Z. Vranesic) Chapter 5
8	Midterm Exam			(S. Brown and Z. Vranesic) Chapter 1-4
	Combinational Circuit Building Blocks		1. Analyze and explain uses of small- and medium-scale logic functions as building blocks. 2. Analyze and design combinational logic networks in a hierarchical, modular approach, using standard and custom logic functions.	(S. Brown and Z. Vranesic) Chapter 6
9	Combinational Circuit Building Blocks		1. Analyze and explain uses of small- and medium-scale logic functions as building blocks. 2. Analyze and design combinational logic networks in a hierarchical, modular approach, using standard and custom logic functions.	(S. Brown and Z. Vranesic) Chapter 6
	Sequential Circuit Elements		1. Contrast the difference between a memory element and a register. 2. Indicate some uses for sequential logic. 3. Design and describe the operation of basic memory elements. 4. Analyze circuits containing basic memory elements. 5. Apply the concepts of basic timing issues, including clocking, timing constrains, and propagation delays during the design process. 6. Analyze and design functional building blocks and timing concepts of digital systems.	(S. Brown and Z. Vranesic) Chapter 7
10	Sequential Circuit Elements		1. Contrast the difference between a memory element and a register. 2. Indicate some uses for sequential logic. 3. Design and describe the operation of basic memory elements. 4. Analyze circuits containing basic memory elements. 5. Apply the concepts of basic	(S. Brown and Z. Vranesic) Chapter 7

			timing issues, including clocking, timing constrains, and propagation delays during the design process. 6. Analyze and design functional building blocks and timing concepts of digital systems.	
	Synchronous State Machine		7. Analyze the behaviour of synchronous machines. 8. Design synchronous sequential machines. 9. Reduce the number of states to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 8
11	Synchronous State Machine		1. Analyze the behaviour of synchronous machines. 2. Design synchronous sequential machines. 3. Reduce the number of states to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 8
12	Synchronous State Machine		1. Analyze the behaviour of synchronous machines. 2. Design synchronous sequential machines. 3. Reduce the number of states to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 8
13	Asynchronous State Machine		1. Analyze the behaviour of asynchronous machines. 2. Design asynchronous sequential machines. 3. Reduce the number of states to simplify circuits used to realize them. 4. Apply state assignment to eliminate race. 5. Apply hazard elimination technique.	(S. Brown and Z. Vranesic) Chapter 9
14	Asynchronous State Machine		1. Analyze the behaviour of asynchronous machines. 2. Design asynchronous sequential machines. 3. Reduce the number of states to simplify circuits used to realize them. 4. Apply state assignment to eliminate race. 5. Apply hazard elimination technique.	(S. Brown and Z. Vranesic) Chapter 9
15	Asynchronous State Machine		1. Analyze the behaviour of asynchronous machines. 2. Design asynchronous sequential machines. 3. Reduce the number of states to simplify circuits used to realize them. 4. Apply state assignment to eliminate race. 5. Apply hazard elimination technique.	(S. Brown and Z. Vranesic) Chapter 9
	Final Exam			All

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3013	***Bobot sks:*** 3	***Semester:*** 4	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Sistem Instrumentasi			
	Instrumentation System			
Silabus Ringkas	Kuliah ini memuat materi tentang peran Instrumentasi pada berbagai bidang rekayasa; karakteristik komponen; methoda pengukuran, methoda kalibrasi, methoda pengolahan data pengukuran. Klasifikasi sensor dan tranduser: mekanik; termal; optik.; akustik, LVDT konversi sinyal, Penguatan dan modulasi, pengkondisi sinyal Analog dan digital, rangkaian Konverter Pengendali akhir, aktuatur mekanik; actuator elektrik, actuator hidrolik; Rangkaian pengendali analog; filter, Pengenalan perekam sinyal, komunikasi, serta peraga dan pembacaan			
	This course contains material about the role of instrumentation system in various fields of engineering; the characteristic of system's components; the method of measurement, the method of calibration, data processing methods in the measurement. Classification of sensor and transducer: mechanical; thermal; optics; acoustic, LVDT signal conversion, amplification and modulation, analog signal conditioning and digital converter circuit, final controller, mechanical actuator; electric actuator; hydraulic actuator; analog controller circuits; filters, signal recordings, communications, and displays and readings			
Silabus Lengkap	Kuliah ini memuat materi tentang peran Instrumentasi pada berbagai bidang rekayasa karakteristik komponen (respon waktu, delay, rambatan sinyal); methoda pengukuran sensor dan tranduser, methoda kalibrasi, methoda pengolahan data pengukuran,. Klasifikasi sensor dan tranduser, konsep penguatan dan modulasi daya. karakteristik penguatan Konsep Pengolah Sinyal dan Pengkondisi sinyal Analog, merancang rangkaian penguatan dan modulasi, karakteristik komponen, pengukuran methoda rangkaian jembatan dalam pengukuran sensor; Konsep Pengolah sinyal dan Pengkondisi sinyal Digital, Filter, macam-macam rangkaian Konverter ADC, DAC, frekuensi to voltage; Macam-macam Sensor mekanik; Sensor termal ;Macam-macam Sensor Optik. Karakteristik sensor mekanik; karakteristik sensor termal dan methoda pengukuran suhu; karakteristik sensor optik.; karakteristik sensor akustik, konversi sinyal dengan methoda oscilator, methoda LVDT, perancangan filter pada sistem instrumentasi ;Aktuator dan Pengendali akhir, Elektronika daya; aktuatur mekanik; elektrik, hidrolik; Rangkaian pengendali analog; berbasis OP-Amp, aktuator, sistem penggerak, kendali proses kejadian diskrit dan pengenalan pengendali digital. instrumentasi: perekam sinyal, komunikasi, serta peraga dan pembacaan.			
Luaran (Outcomes)	• Untuk mengenalkan dan memahami konsep dari sistem kendali mulai dari pemodelan, analisis transient dan steady-state dan kestabilan sistem-sistem linier, hingga perancangan sistem-sistem kendali di domain waktu dan domain frekuensi • Mahasiswa belajar sistem instrumentasi dengan pola top-down dan merancang bagian atau subsitem atau instrumentasi sederhana dengan pengetahuan yang telah dimilikinya atau dengan memodifikasi blok pembangun yang diajarkan. • Mahasiswa mempunyai kemampuan analisis untuk merancang rangkaian pengukuran komponen sensor dan mengkalibrasi sistem sensor, mampu membuat rangkaian pengkondisi sinyal, mampu membuat rangkain insrumentasi pengukuran variabel kendalian. Mampu membuat rangkaian pengendali berbasis Op-Amp, dan mampu membuat rangkaian pengendali daya (penguat daya) berbasis elektronik pada sistem instrumentasi.			
Matakuliah Terkait	EL2005 Elektronika		Prasyarat	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Rangan; Sarma ; Instrumentation Devices and Systems (3rd Edition); Tata McGraw-Hill, New Delhi 1992			
	Rarold Wobschall, Circuit Design for Eelctronic Instrumentation (2nd ed), Mc Grwa Hill, 1987, New York, 1987			
	Halit Eren, Electronic Portable Instruments: Design and Applications, CRC Press, 2003			
	Johnson, Curtis, Process Control Intrumentation Technology, Prentice Hall Inc., Simon & Schuster division, Singapore, Eighth Edition, 2006			
	Op-amp book on nonlinear circuits AND Biomedical instrumentation book			
	Rangan; Sarma ; Instrumentation Devices and Systems, 3 Edition; Tata McGraw-Hill, New Delhi 1992			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Measurement & Electronics Intrumentation System	• Basic concept of mesueremts; sersor & transducer classifications • parts of electronic instrument; IC advantages; interfacing & matching; build or buy; analog or digital • performance charateristics of instrumentation system (zer0, 1st, 2nd order, dead-time, linearity. error, offset, drift	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Operational Amplifiers	• I-V converter, bridge amp.; intrumentation amp.; transconductance op amp; analog multiplier; current differencing amp. • Nonlinear op-amp circuits: hysterisis, precision rectifier, • I-V converter, bridge amp.; intrumentation amp.; transconductance op amp; analog multiplier; current differencing amp. • Comparator; multivibrator; peak detector; output limiter & clipper		
3	Temperature Sensors	Thermistor; linierization;bridge amp for resistance sensors; RTD; thermocouples, IC thermosensor		
4	Electro-optical Sensors	optical spectara & energy relations;photo -diodes & -transistors with lenses; photovoltaic & semiconductor photocells; LED; photomultipliers; optical pyrometer; thermal radiotion detectors; optical isolators		
5	Displacement & Vibration Sensors	strain gauges; inductive & electromagnetic sensors; LVDT; capacitive sensors; piezoelectric; Hall magnetic sensorsl proximity detectors; digital-optical displacement transducers		
6	Chemical & Biological Sensors	reversible & reference electrodes; membrane potentials; pH meter; specific ion electrodes; oxygen & skin electrodes; microelectrodes; ECG & its amplifiers; electric shock hazards; isolation amplifier		
7	Pressure, Force, Fluid Measurement Sensors	• load cells; diaphragm type sensors; silicon pressure transducers; other types; sensors error & nonlinearity • pressure drop flowmeter; other flowmeters; liquid level sensors; sonar level sensors; humidity sensor; moisture		
8	Active Filters	LPF, notch, BPF, HPF active filters; Butterworth & Chebychev filters; state var filters; swithed capacitor filters; voltage tunable filters		
9	A/D and D/A Conversions	D/A specs; V-f converters and its ICs; VFC as A/D converters; D/A converters; counters & servo ADC; Successive approx ADC; Flash ADC		
10	Modulation & Demodulation	Diode rectifiers; AC-DC converters, phase sensistive detectors; Amplitude & Freq modulations, FM detectors; PLL		
11	Noise Reduction	noise sources & terminologies; semiconductor & amplifier noises; BW limitation; signal averaging; signal amplification & processing deisgn example		
12	• Pulse timer & Counters • Multiplexing	Various Pulse timer & Counters; analog switches, MUX & DEMUX; latches; digital switches; Serial-parallel conversion; S/ circuits, charge coupled devices		
13	Power Supplies	PS characteristics; rectifier-capacitor input section; unregulated PS; Zener diode voltage regulators; op-amp regulators;		
14	Power Aplification & Drivers	Power Output Transistors Configurations; highoutput op amps; AC amplifiers; SCR & Triac drives;		
15	Power Aplification & Drivers	small DC motors & drivers; stepping motor Drivers; power circuit design and examples		

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3015	***Bobot sks:*** ***3***	***Semester:*** ***6***	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Sistem Kendali			
	Control Systems			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	The course covers control systems analysis and design for linier systems in case of stability or performance. System analysis and design are implemented using traditional approach in time and frequency domain. Introduction odern concept of state space and digital control system are also provided in the course.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	Ability to analyse and design of control system concepts including modeling, transient analysis, steady-state and linier systems stability, and designing control system in time and frequency domain. Ability to use state space concept for modelling and its connection with transfer function model Ability to analyze and design of simple digital control system			
Matakuliah Terkait	EL2007 Sinyal dan Sistem		Prerequisite	
	EL3215 Praktikum Sistem Kendali		Corequisite	
Kegiatan Penunjang	Laboratorium works and assignments using hardware and MATLAB			
Pustaka	Norman S. Nise, Control System Engineering, John Wiley, 2011, 6th edition (Pustaka Utama)			
	Katsuhiko Ogata, Modern Control Engineering, Prnetice Hall, 2010, 5th edition, (Pustaka Utama)			
	Gene F.Franklin, et al., Feedback Control of Dynamic Systems, Addison Wesley, 1994			
Panduan Penilaian	Assignments, Quizzes, (30%) Midsemester Exam (35%) Final Exam (35%) or (50% with remedial) Remedial Exam (50% with Final exam)			
Catatan Tambahan	Emphasize basic concepts introduction using application examples			

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Basic elements of a control system, concept of feedback, open and closed-loop systems		• Identify the basic elements and structures of feedback control systems. • Derive mathematical model, linearized models and their transfer function representations for SISO system	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Mathematical modeling of physical SISO systems, linearized models, and transfer function		• Derive state space representations of linear systems and its connection to transfer function • Use signal-flow graphs to derive system'ss input-output relations.	
3	• Mathematical modeling of physical SISO systems, linearized models, and transfer function • Time-domain analysis and stability of control systems.		• Use signal-flow graphs to derive system'ss input-output relations. • Correlate the pole-zero configuration of transfer functions and their time-domain response to known test inputs	
4	Time-domain analysis and stability of control systems.		• Apply Routh-Hurwitz criterion to determine the domain of stability of linear time-invariant systems in the parameter space. • Apply Final-value Theorem to determine the steady-state response of stable control systems.	
5	PID controller design for SISO systems		• Explain the effect of each component of PID controller to system's performance • Calculate the PID parameters to meet a closed loop design requirements of 2nd orderd systems	
6	• PID controller design for SISO systems • Feedback control system analysiss & design via root-locus method.		• Apply Ziegler-Nichols methods for PID controller tuning • Construct and recognize the properties of root-locus for feedback control systems with a single variable parameter.	
7	Feedback control system analysiss & design via root-locus method.		• Specify design region in the s-plane in terms of settling-time, rise-time and overshoot to step-response. • Use root-locus method for the design of feedback control systems.	
8	Feedback control system analysiss & design via root-locus method.		• Use root-locus method for the design of feedback control systems. • Synthesize feedback control systems in terms of specified closed-loop pole-zero configuration.	
9	Feedback control system Analysis via frequency-domain method.		• Construct Bode (overview) and polar or Nyquist plots for rational transfer functions.	
10	Feedback control system analysis via frequency-domain method.		• Specify control system performance and stability in Bode plot in terms of gain and phase margins, error steady state coeffiicents • Determine the system's stability based on gain & phase margins and Nyquist criterion	
11	Feedback control system design and implementation via frequency-domain method.		• Design lead compensators to achieve the desired performance using Bode plot	
12	Feedback control system design and implementation via frequency-domain method.		• Design lag compensators to achieve the desired performance using Bode plot • Understand the way to implement an analog controller using electronics components	
13	Introduction to sampled data systems, discrete equivalents, and sample rate selection.		• Design sampled data systems using discrete equivalents. • Understand the effects of sample rate and calculate a suitable sample rate	
14	Introduction to sampled data systems, discrete equivalents, and sample rate selection.		• Determine the stability of sampled data systems using Routh-Hurwitz criterion after bilinear trasformation • Design and implement a discrete time PID controller	
15	• Introduction to sampled data systems, discrete equivalents, and sample rate selection • Analysis & design of feedback control systems using MATLAB		• Design and implement a discrete time PID controller • Analyze and design of practical feedback control systems (continuous and discrete time) using MATLAB	

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL3016	*3*	*4*	Prodi S1 Teknik Elektro	Wajib

Nama Matakuliah	Sistem Komunikasi
	Communication System
Silabus Ringkas	Analog Modulation, Random Signals and Noise, Digital Baseband Pulse Transmission, Digital Bandpass Transmission, Capacity Sharing Technique, Introduction to Channel Coding.
	Analog Modulation, Random Signals and Noise, Digital Baseband Pulse Transmission, Digital Bandpass Transmission, Capacity Sharing Technique, Introduction to Channel Coding.
Silabus Lengkap	AM Modulation/Demodulation, FM Modulation/Demodulation, Quick Review of Probability, Random Processes, Statistical Characterization of Random Processes, Power Spectral Density, Gaussian Random Processes, Noise and Its Representation, Signal-to-Noise Ratio of analog Modulations, Sampling and Pulse Code Modulation (PCM), Wavefrom representation of binary digits, Matched Filters, Probability of Error due to Noise, Intersymbol Interference (ISI), Equalizations, Signal-space representations of Bandpass signals, Detection of Known Signals in Noise, Correlation and Matched Filter Receivers, Binary and non-binary Modulation Techniques, Probability of Error due to Noise of Digital Bandpass Transmission, Non-coherent Detection, Differential Detection, FDMA, TDMA, CDMA, OFDM, Channel coding fundamentals, Linearity and Hamming distance, Coding gain, Random error detection and correction capabilities, Encoding & Decoding, Probability of decoding and bit error.
	AM Modulation/Demodulation, FM Modulation/Demodulation, Quick Review of Probability, Random Processes, Statistical Characterization of Random Processes, Power Spectral Density, Gaussian Random Processes, Noise and Its Representation, Signal-to-Noise Ratio of analog Modulations, Sampling and Pulse Code Modulation (PCM), Wavefrom representation of binary digits, Matched Filters, Probability of Error due to Noise, Intersymbol Interference (ISI), Equalizations, Signal-space representations of Bandpass signals, Detection of Known Signals in Noise, Correlation and Matched Filter Receivers, Binary and non-binary Modulation Techniques, Probability of Error due to Noise of Digital Bandpass Transmission, Non-coherent Detection, Differential Detection, FDMA, TDMA, CDMA, OFDM, Channel coding fundamentals, Linearity and Hamming distance, Coding gain, Random error detection and correction capabilities, Encoding & Decoding, Probability of decoding and bit error.
Luaran (Outcomes)	Compute a modulated analog signal from an analog message signal (modulation) using AM and FM, Compute an analog message signal from an analog modulated signal (demodulation) using AM and FM, Apply the probability in communication systems, Compute the autocorrelation function of a random process, Determine whether a random process is stationary (if possible) or wide-sense stationary (WSS), Determine the power spectral density (PSD) of WSS random processes, Apply the Gaussian random processes in communication system, Determine the mathematical model of noise, Compute the receiver signal-to-noise ratio (SNR) of analog modulations, Explain the sampling theorem and process of PCM, Compare various waveform types of binary signaling, Design a matched filter to facilitate maximum signal-to-noise power ratio, Compute probability of error performance of binary signaling, Design inter-symbol interference-free pulse shapes under bandwidth constraints, Determine equalizer filter to compensate ISI, Find the orthonormal basis functions of a digital modulation system, Analyze a digital modulation system with noise in signal space, computing union bounds on error probability, Compare different detection techniques, Understand and compare of various capacity sharing techniques, Explain the meaning and significance of Shannon's channel coding theorem, Explain how Hamming distance between codewords directly affects the performance of error-correction codes, Explain the encoding and decoding process of channel coding, Compute the probability of decoding and bit error.
Matakuliah Terkait	EL2007 Sinyal dan Sistem — Prasyarat
	EL2004 Probabilty and Statistics — Prasayarat
	EL3216 Praktikum Sistem Komunikasi — Bersamaan/Corequisite
Kegiatan Penunjang	Tugas dan Simulasi
Pustaka	Proakis and Salehi, Digital Communications, 5th ed., McGraw-Hill Science/Engineering/Math, 2007 (pustaka utama)
	Haykin, Communication Systems, 5th ed., Wiley, 2009, (pustaka utama)
	Sklar, Digital Communications: Fundamentals and Applications, 2nd ed., Prentice Hall, 2001 (pustaka alternatif)
	Silage, Digital Communication Systems using MATLAB and Simulink, 1st ed., Bookstand Publishing, 2009 (pustaka pendukung)
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Analog Modulation	AM Modulation/ Demodulation	• Compute a modulated analog signal from an analog message signal (modulation) using AM and FM • Compute an analog message signal from an analog modulated signal (demodulation) using AM and FM	Haykin, Communication Systems
2	Analog Modulation	FM Modulation/ Demodulation	• Compute a modulated analog signal from an analog message signal (modulation) using AM and FM • Compute an analog message signal from an analog modulated signal (demodulation) using AM and FM	Haykin, Communication Systems
3	Random Signals and Noise	• Quick Review of Probability • Random Processes • Statistical Characterization of Random Processes	• Apply the probability in communication systems • Compute the autocorrelation function of a random process • Determine whether a random process is stationary (if possible) or wide-sense stationary (WSS)	• Haykin, Communication Systems • Proakis and Salehi, Digital Communications
4	Random Signals and Noise	• Power Spectral Density • Gaussian Random Processes • Noise and Its Representation	• Determine the power spectral density (PSD) of WSS random processes • Apply the Gaussian random processes in communication system • Determine the mathematical model of noise	• Haykin, Communication Systems • Proakis and Salehi, Digital Communications
5	Random Signals and Noise	• Signal-to-Noise Ratio of analog Modulations	• Compute the receiver signal-to-noise ratio (SNR) of analog modulations.	• Haykin, Communication Systems • Proakis and Salehi, Digital Communications
6	Digital Baseband Pulse Transmission	• Sampling and Pulse Code Modulation (PCM) • Wavefrom representation of binary digits	• Explain the sampling theorem and process of PCM • Compare various waveform types of binary signaling	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
7	Digital Baseband Pulse Transmission	• Matched Filters • Probability of Error due to Noise	• Design a matched filter to facilitate maximum signal-to-noise power ratio • Compute probability of error performance of binary signaling	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
8	Digital Baseband Pulse Transmission	• Intersymbol Interference (ISI) • Equalizations	• Design inter-symbol interference-free pulse shapes under bandwidth constraints • Determine equalizer filter to compensate ISI	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
9	Digital Bandpass Transmission	• Signal-space representations of Bandpass signals • Detection of Known Signals in Noise	• Find the orthonormal basis functions of a digital modulation system • Analyze a digital modulation system with noise in signal space, computing union bounds on error probability • Compare different detection techniques	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
10	Digital Bandpass Transmission	• Correlation and Matched Filter Receivers • Binary and non-binary Modulation Techniques	• Find the orthonormal basis functions of a digital modulation system • Analyze a digital modulation system with noise in signal space, computing union bounds on error probability • Compare different detection techniques	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
11	Digital Bandpass Transmission	• Probability of Error due to Noise of Digital Bandpass Transmission • Non-coherent Detection • Differential Detection	• Find the orthonormal basis functions of a digital modulation system • Analyze a digital modulation system with noise in signal space, computing union bounds on error probability • Compare different detection techniques	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
12	Capacity Sharing Technique	• FDMA • TDMA	Understand and compare of various capacity sharing techniques	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
13	Capacity Sharing Technique	• CDMA • OFDM	Understand and compare of various capacity sharing techniques	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
14	Introduction to Channel Coding	• Channel coding fundamentals • Linearity and Hamming distance • Coding gain • Random error detection and correction capabilities	• Explain the meaning and significance of Shannon's channel coding theorem • Explain how Hamming distance between codewords directly affects the performance of error-correction codes	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications
15	Introduction to Channel Coding	• Encoding & Decoding • Probability of decoding and bit error	• Explain the encoding and decoding process of channel coding • Compute the probability of decoding and bit error	• Proakis and Salehi, Digital Communications • Sklar, Digital Communications: Fundamentals and Applications

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3014	***Bobot sks:*** 3	***Semester:*** 4	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Sistem Mikroprosesor			
	Microprocessor System			
Silabus Ringkas	Pada kuliah ini diajarkan tentang sistem mikroprosesor serta implementasi hardware sistem mikroprosesor berbasis mikrokontroler 8 bit, antar muka analog & digital, periferal dan serial/paralelkomunikasi, serta proyek perancangan sebuah sistem mikroposesor			
	This course covers topics microprocessor systems and the hardware implementation based on 8-bit microprocontroller, analog & digital interfaces, peripherals & parallel/serial communication, and the design project of microprocessor systems			
Silabus Lengkap	Pada kuliah ini diajarkan tentang sistem mikroprosesor serta implementasi hardware sistem mikroprosesor berbasis mikrokontroler 8 bit . Peranan sistem mikroprosesor, arsitektur sistem mikroprosesor, address decoder, antar muka digital, antar muka analog, periferal, komunikasi serial, tool chain, proyek perancangan			
	This course covers topics on 8-bit microprocessor systems and the hardware implementation of the microprocessor system. The role of microprocessor systems, microprocessor system architecture, address decoder, digital interfaces, analog interfaces, peripherals, serial communication, tool chain, the project design			
Luaran (Outcomes)	7. Memahami arsitektur sistem mikroprosesor 8. Menjelaskan cara kerja sistem mikroprosesor 9. Merancang address decoder 10. Menggunakan toolchain untuk membuat software sampai memasukkannya ke mikrokontroler 11. Membuat software berbasis arsitektur super loop dan interupsi 12. Memahami periferal internal mikrokontroler 13. Merancang antar muka digital dan analog 14. Menggunakan komunikasi serial 15. Merancang dan mengimplementasikan sistem mikrokontroler meliputi hardware dan software			
Matakuliah Terkait	EL2008 Pemecahan Masalah dengan C	Prasyarat		
	EL2005 Elektronika	Prasyarat		
	EL3214 Praktikum Sistem Mikroprosesor	Bersamaan		
Kegiatan Penunjang	Praktikum Sistem Mikroprosesor			
Pustaka	Ardi Winoto, *Mikrokontroler AVR ATmega8/32/16/8535 dan Pemrogramannya dengan Bahasa C pada WinAVR*			
	Ronald J Tocci, Neal S Widmer, Gregory L Moss, *Digital Systems Principles and Applications 10th edition*, Pearson, 2007;			
	Dhananjay Gadre, *Programming And Customizing the AVR Microcontroller*, Mc Graw Hill, 2001			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pengenalan	1. Implementasi sistem digital 2. peranan sistem mikroprosesor 3. Sejarah Mikroprosesor	• Mengetahui peranan sistem mikroprosesor • Menjelaskan sejarah mikroprosesor & mikrokontroler (4004 dst) •	
2	Arsitektur Sistem Mikroprosesor	Arsitektur Umum	• Menjelaskan cara kerja sistem mikroprosesor • menjelaskan cara kerja bus, • timing pada bus • tahu Von neumann vs Harvard	
3		Stack dan interupsi	• menjelaskan peran stack pada interrupt • menjelaskan cara kerja interupsi , termasuk hubungannya dengan stack	
4		Address Decoder	• Membuat peta memori • Merancang address decoder dalam persamaan Boolean & rangkaian • Menghitung timing akses memory •	
5	Software Mikroprosesor	Arsitektur Software	• Membuat software dengan arsitektur super loop • Membuat software dengan arsitektur foreground background (interrupt) • Membuat flow chart program	
6		Periferal mikrokontroler	• Mengetahui cara kerja periferal internal mikrokontroler • membuat software untuk memakai timer, adc, pwm • Membuat software & hardware untuk memakai ADC • Aplikasi PWM	

7	Komunikasi Serial		• Memahami cara kerja komunikasi serial • Membuat software komunikasi serial	
8	Microprocessor Toolchain		• Membuat software sampai menjalankannya ke dalam mikrokontroler • Melakukan proses debugging	
9	Antar Muka	Digital I/O	• Merancang hardware & software untuk mengakses LED, switch, 7 segment, LED matrix, keypad matrix	
10		Analog I/O	• Merancang hardware & software untuk mengakses perangkat analog seperti sensor temperatur LM35 dan sensor cahaya	
11	Hardware Sistem Mikroprosesor		• Tahu hardware sistem mikroprosesor secara umum • Tahu teknik reduksi derau	
12	Perancangan Mikroprosesor		• Metodologi perancangan • System Engineering (ringkas)	
13	Perancangan Mikroprosesor		•	
14	Perancangan Mikroprosesor (2hr)		• Merancang sistem mikroprosesor sederhana sesuai dengan metodologi perancangan baku	
14	Operating System (1 hr)		• Merancang sistem mikroprosesor sederhana sesuai dengan metodologi perancangan baku	
15	Operating System (3hr)		Menjelaskan konsep concurrency, context switch, layering OS	

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3017	***Bobot sks:*** 3	***Semester:*** 6	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Sistem Tenaga Elektrik			
	Power Systems			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	This course is an introductory subject in the field of electric power systems and electrical to mechanical energy conversion. Electric power has become increasingly important as a way of transmitting and transforming energy in industrial, military and transportation uses. Examples of new uses for electric power include all manners of electric transportation systems (electric trains that run under catenary, diesel-electric railroad locomotion, 'maglev' medium and high speed tracked vehicles, electric transmission systems for ships and diesel-electric locomotives, replacement of hydraulics in high performance actuators, aircraft launch and recovery systems, battery powered factory material transport systems, electric and hybrid electric cars and buses, even the 'more electric' airplane). Electric power systems are also at the heart of alternative energy systems, including wind and solar electric, geothermal and small scale hydroelectric generation.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	The course material includes: • fundamentals of energy-handling electric circuits, power electronic circuits such as inverters, and electromechanical apparatus • modeling of magnetic field devices and description of their behavior using appropriate models • simplification of problems using transformation techniques • analysis of power electric circuits, magnetic circuits, and elements of linear and rotating electric machinery • use of lumped parameter electromechanics to understand power systems • models of synchronous, induction, and DC machinery • the interconnection of electric power apparatus and operation of power systems			
Luaran (Outcomes)	[*Uraian hasil/luaran (kompetensi mahasiswa) yang diharapkan setelah penyelesaian matakuliah ini*]			
Matakuliah Terkait	EL2001 Rangkaian Elektrik	Prasyarat		
	EL3217 Praktikum Sist.Tenaga Elektrik	Bersamaan		
Kegiatan Penunjang	Praktikum			
Pustaka	Kirtley, James. Electric Power Principles: Sources, Conversion, Distribution and Use. Wiley, 2010			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Electrical Energy, Active and Reactive Power • Power System Network Matrices Analysis and Computation	• Electric power generation and transmission and distribution system • Primary source of generating plant • Concept of active and reactive power for single phase and three phase system • Simple calculation of active power, reactive power and complex power • Energy consumption and daily load curve, load duration curve • Power factor, demand factor, coincident factor, utility factor • DC versus AC system • Incidence matrices for simple power system network	• Memahami konsep daya aktif dan daya reaktif melakukan perhitungan untuksistem 1single phase, 3 phase dan multi phasa • Mampu memahami dan menghitung konsumsi energi listrik dan damak karakteristik kurva beban terhadap pemakaian listrik • Mampu melakukan perhitungan aspek keserempakan beban dan loading komponen • Mampu melakukan perhitungan matrik incidence dari pengaruhnya perubahan jaringan	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Power System Network Matrices Analysis and Computation	• Incidence matrices for simple power system network • Primitive network, formation of network matrices • Balanced and unbalanced network element • Y-matrices and Z matrices	• Mampu melakukan perhitungan matrik incidence dari pengaruhnya perubahan jaringan • Mampu membentuk matrik Y Bus dan Z bus dengan menggunakan branch and bound methods • Mampu menghitung matrik impedansi jaringan sistem tenaga	
3	Per-unit systems and Transmission Lines Parameters	• Per unit representation, power and circuits formula in per unit system • Transmission lines model representation • Underground cable and overhead transmission lines • Resistance, inductance and capacitance and Voltage drop calculation. • Calculation of power losses and line sizing	• Mampu melaukan dalam per unit system untuk semua besaran dan komponen di sistem tenaga • Mampu melakukan menghitung parameter model saluran transmisi dan distribusi listrik baik kabel maupun saluran udara • Mampu melakukan sizing terdapat pemilihan karakteristik saluran transmisi dan distribusi dengan kriteria yang diberikan • Mampu memodelkan dengan menggunakan MAthLAb untuk saluran kabel dan saluran udara	
4	Transformers and Electrical Machine	• Concept of transformers, design features, physical transformers • Accounting for magnetizing and core loss and winding losses • Three phase transformers and its connection	• Memahami proses dan mekanisme trafo dan pemodelannya • Mampu membuat model dan karakteristik trafo serta menurunkan parameter trafo dari data pengujian trafo • Mampu melakukan perhitungan kapasitas trafo untuk keperluan tertentu	
5	Transformers and Electrical Machine	• Classical machine description • Voltage generation, open circuit voltage, armature reaction and terminal voltage • Power delivered by generator, synchronizing generator to Grid	• Mampu melakukan pemodelan mesin listrik dan • Mampu menurunkan parameter mesin dari hasil pengujian.	
6	• Transformers and Electrical Machine • Power Flow Analysis and Voltage Control System	• Role of synchronous machine excitation in controlling reactive power • Transient machine behavior • Calculation simple power flow in power system network		
7	Power Flow Analysis and Voltage Control System	• Power flow calculation using Gauss Seidel iteration, Newton Raphson • Using MatLab for power flow calculation • Mechanism for voltage improvement in power system network		
8	Short Circuits and Unbalanced System Operation	• Short circuits characteristics in power system network • Simple short circuit calculation using IEC and		

		ANSI standard		
9	• Short Circuits and Unbalanced System Operation • Power System Control : Voltage and Frequency Control	• Electrical component sizing based on short circuit calculation • Mechanism for voltage improvement in power system network		
10	Power System Control : Voltage and Frequency Control	• Mechanical power and governor system and secondary control • Load sharing (active and reactive) based on droop and isochronous		
11	• Power System Control : Voltage and Frequency Control • Harmonic and Power Quality	• Dynamic system of generating plant • Harmonic characteristics and source of harmonics		
12	Harmonic and Power Quality	• Introduction for Distortion Power Factor, true RMS measurement • Minimizing harmonic in power system network. (active filter introduction)		
13	Overvoltage Protection	• Overvoltage phenomena Lightning and switching transient • Overvoltage protection for low voltage system • Grounding system TN, TT, TNC , TNCS for LV system		
14	Over current Protection System	• Need for over current protection and its measure • Characteristics of over current protection, (fuse, relay, thermal, magnetic) • Earth leakage • Simple coordination protection system		
15	SCADA System and Smart Grid	• Concept of SCADA and its benefit for power system network • Simple calculation for tele-measurement and tele-control and alarm calculation • Master control /station system configuration and its software requirements • Smart Grid concepts • Renewable Energy		

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3017	***Bobot sks:*** 3	***Semester:*** 6	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Sistem Tenaga Elektrik			
	Power Systems			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	This course is an introductory subject in the field of electric power systems and electrical to mechanical energy conversion. Electric power has become increasingly important as a way of transmitting and transforming energy in industrial, military and transportation uses. Examples of new uses for electric power include all manners of electric transportation systems (electric trains that run under catenary, diesel-electric railroad locomotion, 'maglev' medium and high speed tracked vehicles, electric transmission systems for ships and diesel-electric locomotives, replacement of hydraulics in high performance actuators, aircraft launch and recovery systems, battery powered factory material transport systems, electric and hybrid electric cars and buses, even the 'more electric' airplane). Electric power systems are also at the heart of alternative energy systems, including wind and solar electric, geothermal and small scale hydroelectric generation.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	The course material includes: • fundamentals of energy-handling electric circuits, power electronic circuits such as inverters, and electromechanical apparatus • modeling of magnetic field devices and description of their behavior using appropriate models • simplification of problems using transformation techniques • analysis of power electric circuits, magnetic circuits, and elements of linear and rotating electric machinery • use of lumped parameter electromechanics to understand power systems • models of synchronous, induction, and DC machinery • the interconnection of electric power apparatus and operation of power systems			
Luaran (Outcomes)	[*Uraian hasil/luaran (kompetensi mahasiswa) yang diharapkan setelah penyelesaian matakuliah ini*]			
Matakuliah Terkait	EL2001 Rangkaian Elektrik	Prasyarat		
	EL3217 Praktikum Sist.Tenaga Elektrik	Bersamaan		
Kegiatan Penunjang	Praktikum			
Pustaka	Kirtley, James. Electric Power Principles: Sources, Conversion, Distribution and Use. Wiley, 2010			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Electrical Energy, Active and Reactive Power • Power System Network Matrices Analysis and Computation	• Electric power generation and transmission and distribution system • Primary source of generating plant • Concept of active and reactive power for single phase and three phase system • Simple calculation of active power, reactive power and complex power • Energy consumption and daily load curve, load duration curve • Power factor, demand factor, coincident factor, utility factor • DC versus AC system • Incidence matrices for simple power system network	• Memahami konsep daya aktif dan daya reaktif melakukan perhitungan untuksistem 1single phase, 3 phase dan multi phasa • Mampu memahami dan menghitung konsumsi energi listrik dan damak karakteristik kurva beban terhadap pemakaian listrik • Mampu melakukan perhitungan aspek keserempakan beban dan loading komponen • Mampu melakukan perhitungan matrik incidence dari pengaruhnya perubahan jaringan	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Power System Network Matrices Analysis and Computation	• Incidence matrices for simple power system network • Primitive network, formation of network matrices • Balanced and unbalanced network element • Y-matrices and Z matrices	• Mampu melakukan perhitungan matrik incidence dari pengaruhnya perubahan jaringan • Mampu membentuk matrik Y Bus dan Z bus dengan menggunakan branch and bound methods • Mampu menghitung matrik impedansi jaringan sistem tenaga	
3	Per-unit systems and Transmission Lines Parameters	• Per unit representation, power and circuits formula in per unit system • Transmission lines model representation • Underground cable and overhead transmission lines • Resistance, inductance and capacitance and Voltage drop calculation. • Calculation of power losses and line sizing	• Mampu melaukan dalam per unit system untuk semua besaran dan komponen di sistem tenaga • Mampu melakukan menghitung parameter model saluran transmisi dan distribusi listrik baik kabel maupun saluran udara • Mampu melakukan sizing terdapat pemilihan karakteristik saluran transmisi dan distribusi dengan kriteria yang diberikan • Mampu memodelkan dengan menggunakan MAthLAb untuk saluran kabel dan saluran udara	
4	Transformers and Electrical Machine	• Concept of transformers, design features, physical transformers • Accounting for magnetizing and core loss and winding losses • Three phase transformers and its connection	• Memahami proses dan mekanisme trafo dan pemodelannya • Mampu membuat model dan karakteristik trafo serta menurunkan parameter trafo dari data pengujian trafo • Mampu melakukan perhitungan kapasitas trafo untuk keperluan tertentu	
5	Transformers and Electrical Machine	• Classical machine description • Voltage generation, open circuit voltage, armature reaction and terminal voltage • Power delivered by generator, synchronizing generator to Grid	• Mampu melakukan pemodelan mesin listrik dan • Mampu menurunkan parameter mesin dari hasil pengujian.	
6	• Transformers and Electrical Machine • Power Flow Analysis and Voltage Control System	• Role of synchronous machine excitation in controlling reactive power • Transient machine behavior • Calculation simple power flow in power system network		
7	Power Flow Analysis and Voltage Control System	• Power flow calculation using Gauss Seidel iteration, Newton Raphson • Using MatLab for power flow calculation • Mechanism for voltage improvement in power system network		
8	Short Circuits and Unbalanced	• Short circuits characteristics in power		

	System Operation	system network • Simple short circuit calculation using IEC and ANSI standard		
9	• Short Circuits and Unbalanced System Operation • Power System Control : Voltage and Frequency Control	• Electrical component sizing based on short circuit calculation • Mechanism for voltage improvement in power system network		
10	Power System Control : Voltage and Frequency Control	• Mechanical power and governor system and secondary control • Load sharing (active and reactive) based on droop and isochronous		
11	• Power System Control : Voltage and Frequency Control • Harmonic and Power Quality	• Dynamic system of generating plant • Harmonic characteristics and source of harmonics		
12	Harmonic and Power Quality	• Introduction for Distortion Power Factor, true RMS measurement • Minimizing harmonic in power system network. (active filter introduction)		
13	Overvoltage Protection	• Overvoltage phenomena Lightning and switching transient • Overvoltage protection for low voltage system • Grounding system TN, TT, TNC , TNCS for LV system		
14	Over current Protection System	• Need for over current protection and its measure • Characteristics of over current protection, (fuse, relay, thermal, magnetic) • Earth leakage • Simple coordination protection system		
15	SCADA System and Smart Grid	• Concept of SCADA and its benefit for power system network • Simple calculation for tele-measurement and tele-control and alarm calculation • Master control /station system configuration and its software requirements • Smart Grid concepts • Renewable Energy		

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Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4090	***Bobot sks:*** 3	***Semester:*** 7	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Tugas Akhir I (Capstone Design)			
	Final Project I (Capstone Design)			
Silabus Ringkas	Kuliah mencakup kegiatan perencanaan suatu projek rekayasa skala kecil/ sederhana yang akan dilanjutkan pengerjaannya menjadi tugas akhir 2. Hasil akhir dari kuliah ini adalah dokumen rekayasa B100 (product concept), B200 (persyaratan rancangan), dan B300 (preliminary design)			
	The student is planned to do preliminary study / design of her / his final-year project. Under his / her supervisor, the student has to submit the final-year proposal, abstract and finally full paper which should be presented in student's seminar. The student has to work in the laboratory to do his / her research during the semester time.			
Silabus Lengkap	Kuliah ini merupakan studi awal / desain awal dari Tugas Akhir mahasiswa yang akan diteruskan pada matakuliah Tugas Akhir 2. Dengan demikian, mahasiswa harus sudah memiliki Pembimbing TA sejak awal kuliah. Mahasiswa harus membuat proposal Tugas Akhirnya bersama-sama dengan Pembimbing dan diserahkan kepada koordinator Kuliah pada jadwal yang ditentukan. Kuliah tatap muka memberikan penjelasan tentang pelaksanaan kuliah / Tugas Akhir, plagiarism, penilaian, penyusunan proposal serta dokkumen rekayasa B100 s/d B600, penulisan Abstrak, penulisan paper, jadwal-jadwal waktu pemasukan tugas-tugas dan presentasi, dan teknik-teknik penelitian dan presentasi dalam beberapa pekan kuliah yang dijadwalkan. Mahasiswa harus melaksanakan Tugas Akhir I nya di laboratorium yang telah disepakati bersama dengan Pembimbingnya sesuai dengan proposal yang telah disusun. Dokumen rekayasa B100 (product concept), B200 (persyaratan rancangan), dan B300 (preliminary design) dibuat oleh satu untuk satu tim (2-3 orang) dengan pemantauan progres terjadwal.			
Luaran (Outcomes)	This course is intended as the capstone of all the knowlegde in Electrical Engineering Kegiatan Tugas Akhir ditujukan untuk memberikan pengalaman kepada mahasiswa pada sebuah siklus proses perancangan rekayasa yang lengkap pada sebuah kasus penyelesaian masalah rekayasa nyata (capstone design). Selain itu, pengerjaan dalam tim yang membutuhkan soft-skill (kerjasama, komunikasi, multidisiplin, tanggung jawab, kedisplinan, dll) diharapkan terbangun dalam proses ini.			
Matakuliah Terkait	Lulus minimal 104 sks (lihat catatan tambahan)		Prasayarat	
	EL4018 Etika Profesi & Rekayasa		Bersamaan	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Aciek Ida WS, Tata Cara PEnulisan Buku Tugas Akhir (?), Teknik Elektro ITB, 2004.			
	Plagiarism reference (notes, books etc)			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Written Document 60% Logbook 20% Progress report seminar 20%			
Catatan Tambahan	Syarat Tambahan: (1) Lulus semua MK Tk.2, dan (2) Lulus min 5 MK breadth Tk3, dan (3) Sudah melaksanakan KP minimal 1 bulan, dan (4) Lulus minimal 104 SKS			

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	[*Cantumkan Topik bahasan*]	[*Uraikan sub-topik bahasan*]	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4091	***Bobot sks:*** 3	***Semester:*** 8	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Wajib
Nama Matakuliah	Tugas Akhir II (Capstone Design)			
	Final Project II (Capstone Design)			
Silabus Ringkas	Kuliah mencakup kegiatan lanjutan projek rekayasa skala kecil/ sederhana di matakuliah El4090. Hasil akhir dari kuliah ini adalah dokumen rekayasa B100 s/d B600. Tiap anggota tim juga harus membuat laporan dan makalah dari kontribusinya dan menampilkannnya pada acara presentasi/seminar, poster , dan demo dengan penilai dari 3 orang dosen.			
	In this individual assignment, the student should continue her/his previous work in EL4090 course under the same supervisor. The work resulted in this project could be in the form of any implementation (software/hardware), even in the form of recommendation of solution to the electrical engineering problems. At the end of this project, the student should write the final report, and then defended in front of 3 examiners (lecturers).			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	This course is intended as the capstone of all the knowlegde in Electrical Engineering Kegiatan Tugas Akhir ditujukan untuk memberikan pengalaman kepada mahasiswa pada sebuah siklus proses perancangan rekayasa yang lengkap pada sebuah kasus penyelesaian masalah rekayasa nyata (capstone design). Selain itu, pengerjaan dalam tim yang membutuhkan soft-skill (kerjasama, komunikasi, multidisiplin, tanggung jawab, kedisplinan, dll) diharapkan terbangun dalam proses ini.			
Matakuliah Terkait	EL4090 Tugas Akhir I (Capstone Design)		Prerequisite	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Written Final Project Report 35% Logbook 30% Paper, Seminar & Demo 35%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	[*Cantumkan Topik bahasan*]	[*Uraikan sub-topik bahasan*]	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4130	***Bobot sks:*** 3	***Semester:*** 7	***KK / Unit Penanggung Jawab:*** Elektronika	***Sifat:*** Pilihan
Nama Matakuliah	Analisis dan Perancangan IC Digital			
	Analysis and Design of Digital IC			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	Introduction to CMOS devices, manufacturing technology, CMOS inverters and gates. The course includes the understanding of CMOS design parameters and methodology such as propagation delay, noise margins, and power dissipation digital circuits with respect to different quality metrics: cost, speed, power dissipation, and reliability. The course also teaches the student to design and optimize the standard cell of combinatorial and sequential digital circuits			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	1. Participants understand the Digital IC methodology 2. Participants understand the factors that affect the performance of Digital IC 3. Participants can design combinatorial and sequential standard cell IC 4. Participants can design a simple system.			
Matakuliah Terkait	EL 2002 Sistem Digital		Prasyarat	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Basics of CMOS Cell Design , by Etienne Sicard, Sonia Delmas Bendhia			
	Digital Integrated Circuits (2nd Edition) by Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic			
	CMOS VLSI Design: A Circuits and Systems Perspective (3rd Edition) by Neil H.E. Weste and David Harris			
	Modern VLSI Design: System-on-Chip Design (3rd Edition) by Wayne Wolf			
Panduan Penilaian	Assignments (20%), Midterm Project (30%), Final Project (50%)			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	• Introduction to Digital Integrated Circuits • MOS Devices Technology	• Introduction, overview of MOS Device structures and process technology, and Design Parameters • Design Rules	• To introduce a technology priciples and applications • Function of Design Rules	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	MOS Devices Technology	• Design Rules • Layout Design and Analysis Tools		
3	MOS Devices Technology	MOS Modeling		
4	Inverters	CMOS Invereters Structurs and Characteristics		
5	Inverters	• CMOS Invereters Structurs and Characteristics • Propagation Delay • Inverter Sizing		
6	• Inverters • Interconnects	• Inverter Sizing • Interconnect Design Rule and Characteristics		
7	• Interconnects • Gate Design and layout	• Interconnect Design Rule and Characteristics • Basic GateDesign		
8	Gate Design and layout	• Basic GateDesign • Complex Gate Design		
9	Combinational Logic	• Combinational Logic Design • Arithmatic Combinational Logic Design		
10	• Combinational Logic • Sequential Logic	• Arithmatic Combinational Logic Design • Sequential Logic Components Design		
11	• Sequential Logic • Analog Cell	• Analog Cell Design • Sequential Logic Components Design		
12	• Analog Cell • Project - I	• Analog Cell Design • Digital Logic Timming Issues • A Very-Simple-Microprocessor		
13	• Project – I • Memories	• A Very-Simple-Microprocessor • Memory Design • Combinational Design Principle and Guideline • Sequential Design Principle and Guideline • Design for syntehsis and Constrain		
14	Project - II	• Project Formulation, Design, Implementation and Verification • Design methodology • Modul Design	• Provide students an opportunity to practice team work and communicate their design experience orally and in writing • Learn to design a complete system	
15	Project - II	• Modul Design • Design Verification		

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	***Bobot sks:***	***Semester:***	***KK / Unit Penanggung Jawab:***	***Sifat:***
El4129	3	7	Elektronika	Pilihan
Nama Matakuliah	Devais Semikonduktor			
	Semiconductor Devices			
Silabus Ringkas	Review material semikonduktor, sambungan PN, Kapasitor MOS, MOSFET, Transistor Bipolar, Devais semikonduktor aplikasi khusus			
	Review on semiconductor material, PN junction, MOS capacitor, MOSFET, Bipolar Transistor, and application specific semiconductor devices			
Silabus Lengkap	Review material semikonduktor: representasi kristal, konsep band energi; sambungan PN: kondisi thermal equilibrium, karakteristik arus tegangan; Kapasitor MOS, MOSFET: diagram band energi dan karakteristik arus-tegangan untuk mode saturasi, linier, dan cut off; Transistor Bipolar: mode oparasi BJT, penguatan arus; Devais semikonduktor aplikasi khusus: devais optik, power,			
	Review on semiconductor material: kristal, band energy concept, carrier transport; PN junction: equilibrium, band energy diagram, IV characteristics, MOS capacitor, MOSFET: band energy and IV characteristic in saturation, linear, and cut off mode; Bipolar Transistor: mode of operation, current amplification; and application specific semiconductor devices: optic and power			
Luaran (Outcomes)	Memahami elektronika fisika devais-devais aktif elektronika dan mampu melakukan analisis terhadap karakteristik yang dimulai dengan menurunkan karakteristik Orde Pertama Arus-Tegangan (Karakteristik I-V). Analisis mengikutsertakan pemodelan devais untuk simulasi rangkaian (SPICE)			
Matakuliah Terkait	EL3012 Material Teknik Elektro		Prasyarat	
	EL2005 Elektronika		Prasyarat	
Kegiatan Penunjang				
Pustaka	S.M. Sze, Semiconductor devices Physics and Technology, 2nd Ed, John Wiley, 2002 (Pustaka utama)			
	Donald A. Neamen, Semiconductor Physics and Devices Basic Principles, 3rd Ed, McGraw Hill, 2003 (Pustaka alternatif)			
	J.P. Colinge & C. A. Colinge, Physics of Semiconductor Devices, Kluwer Academic (Pustaka alternatif)			
Panduan Penilaian	30% Kuis dan PR + 30% UTS + 40% UAS			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pengenalan	Pengenalan kuliah,	Mahasiswa memahami aturan perkuliahan: jadwal kuliah, ruang lingkup, danskema penilaian.	
2	Perkembangan devais dan teknologi semikonduktor	Perkembangan devais dan teknologi semikonduktor	Mahasiswa mengetahui sejarah perkembangan devais dan teknologi semikonduktor.	Sze, Ch. 1
3	Review material physic (1)	Kristal semikonduktor, konsep band energi, pita konduksi dan pita valensi, doping dan ketidak murnian, semikonduktor intrinsik dan ekstrinsik	Mahasiswa memahami konsep band energi suatu atom, pita konduksi dan valensi elektron, dan konsep band gap energy, konsep doping: donor dan aseptor elektron, dan efeknya terhadap karakteristik material serta diagram band energi	Sze, Ch. 2
4	Review Material Physic (2)	Drift VS difusi, carrier scattering dan mobilitas, rapat arus dalam material	Mahasiswa memahami mekanisme fisis pembawa muatan, konsep mobilitas, dan menghitung rapat arus. Mengetahui efek doping terhadap karakteristik arus.	Sze, Ch. 3
5	Sambungan PN	Kondisi thermal equilibrium, daerah deplesi, kapasitansi deplesi, karakteristik arus tegangan, efek bias	Mahasiswa memahami proses fisis pada suatu sambungan PN, karakteristik arus tegangan dan efek pemasangan bias pada sambungan PN	Sze, Ch. 4
6	Dioda Sambungan PN	Rapat arus, pemodelan, arus generasi dan rekombinasi, charge storage dan karakteristik transien, breakdown, fabrikasi dioda	Mahasiswa memahami rapat arus dioda, pemodelan, kondisi dadal/breakdown suatu sambungan PN, memahami proses pembuatan suatu dioda sambungan PN	Sze, Ch. 4
7	Kontak metal-semikonduktor	Schottky diode dan kontak ohmic: diagram band energi, karakteristik arus tegangan, hetero junction	Mahasiswa memahami konsep fisis suatu sambungan metal dan semikonduktor, serta karakteristik arus tegangan.	Sze, Ch. 7
8	JFET, MESFET, Kapasitor MOS	Struktur JFET dan MOSFET, thermal equilibrium, struktur MOS, band diagram, dan lapisan deplesi	Mahasiswa memahami struktur dan karakteristik Junction FET, membandingkannya dengan struktur MOSFET, mengetahui band diagram dan karakteristik deplesinya	Sze, Ch. 6
9	MOSFET (1)	Konsep tegangan Threshold, mode operasi MOSFET	Mahasiswa memahami cara kerja MOSFET, mode operasi mosfet berdasar tegangan gate, dan menguasai konsep tegangan threshold.	Sze, Ch. 6
10	MOSFET (2)	karakteristik arus tegangan, modeling, fabrikasi MOSFET	Mahasiswa memahami dan mampu menjelaskan karakteristik MOSFET pada berbagai mode operasi: cut off, linier, dan saturasi. Mampu memodelkan dan mengetahui proses fabrikasi MOSFET.	Sze, Ch. 6
11	BJT (1)	Struktur BJT, short channel VS long channel, mode operasi, karakteristik statis	Mahasiswa memahami struktur dan prinsip dasar operasi transistor bipolar. Memahami karakteristik statis, mampu membedakan karakteristik short dan long channel BJT.	Sze, Ch. 5
12	BJT (2)	Respon frekuensi, penguatan arus, pemodelan, fabrikasi BJT	Mahasiswa memahami respon frekuensi BJT, memahami mekanisme penguatan arus dalam BJT, dan proses dasar fabrikasi BJT.	Sze, Ch. 5
13	Power devices	Thyristor, power devices,	Mahasiswa memahami struktur, cara beroperasi, dan karakteristik power devices	Sze, Ch. 5
14	Optical devices	Photovoltaic cell, laser, LED, photo absorption and luminescence	Mahasiswa memahami struktur, cara beroperasi, dan karakteristik optical devices	Sze, Ch. 9
15	Quantum devices	Electron tunneling and tunnel junction, tunnel diode, nanoscale devices, single electron transistor	Mahasiswa memahami konsep fisika kuantum yang mendasari pengembangan struktur, cara beroperasi, dan karakteristik quantum devices	Sze, Ch. 8

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4241	***Bobot sks:*** 3	***Semester:*** 8	***KK / Unit Penanggung Jawab:*** Elektronika	***Sifat:*** Pilihan

Nama Matakuliah	Mikroelektronika RF dan Mixed Signal
	RF and Mixed Signal Microelectronics
Silabus Ringkas	Introduksi, Rangkaian Kutub-2 RF:Parameter S (catttering) ; Jalur Transmisi : 'Distributed element', Konstanta propagasi, Koefisien refleksi, Γ; Smith Chart, Teknik Penyesuaian impedansi; Penguat RF (Desain): Kestabilan, Penguatan Daya dan Penyesuaian Impedansi Simultan; Desain Penguat RF Sinyal Kecil; Penguat Derau Rendah (LNA), Teknik 'Mixer' Sinyal dan Osilator ; Pemrosesan Baseband (Introduksi), Modulasi / Demodulasi Dijital, Teknik Pengkodean Dijital, Osilator Terkontrol Numerik, Konversi Sinyal Dijital, Pemrosesan Sinyal Dijital ⇔Analog : DAC/ADC Kecepatan tingi, 'Filtering' FIR
	Introduction, RF 2-port network: Parameter Z,Y,T (cascade), H(ybrid) and S(catttering), Parameter Conversion : S ⇔ parameter Z, Y, H, T, Implementation : Modeling of RF Transistor ; Transmisission Lines : Distributed element, Propagation Constant and Impedance Characteristics, reflection constant, Γ and VSWR; Bilinear transform : Z = f (Γ), Smith Chart, Impedance Maching Techniques; Design RF Amplifier : Stability, Power Gain and techniques of impedance matching (simultaneous) ; Small signal RF Amplifier Design; Low Noise Amplifier (LNA) Design, Signal Mixing (Mixer) and Oscillator Design ; Baseband Processing (Introduction), Digital Modulation / Demodulation, Digital Coding/Decoding, NCO, Digital Frequency Conversion, Digital Signal Processing ⇔ Analog : High Speed DAC/ADC, FIR Filtering
Silabus Lengkap	Introduksi : Elektronika RF/Microwave vs LF, Rangkaian Kutub-2, Kutub-2 di frekuensi tinggi/RF: Parameter S (catttering), Kutub-2 : Transistor RF (Model Rangkaian Pengganti), konvesi S ⇔ parameter Z, Y, H(ybrid) atau T(cascade), Jalur Transmisi : Distributed element ; Konstanta propagasi, (γ, β dan α), karakteristik impedansi (ZO), Koefisien refleksi, Γ dan VSWR; Bilinear transform : Pemetaan Z = f (Γ), definisi Smith Chart, Penyesuaian impedansi : teknik penyesuaian shunt /seri : lumped, line-stub : Penguat RF : definisi kestabilan : Lingkaran Kestabilan (Stability Circle), Faktor Kestabilan , Deskripsi Penguatan (Gain) : Lingkaran Penguatan Daya (Gain Circle) ; Penyesuaian Impedansi 'Conyugate' Simultan (Simultaneous Conjugate Match), Desain Penguat RF Sinyal Kecil; Introduksi : Desain Penguat Derau Rendah (LNA), teknik mixer dan Osilator, Pemroses Baseband (Introduksi), Modulasi/Demodulasi Digital, Pengkodean Dijital Enkoder/Dekoder, NCO (Numerical Controlled Oscilator), DUC/DDC (Digital Up /Down Conversion), Pemroses Sinyal Dijital ⇔ Analog : DAC/ADC Kecepatan Tinggi, Penyaring FIR
	Introduction : Elektronika RF/Microwave vs LF, Mixed Signal Electronics ; RF 2-port Network : S(cattering) Parameter, Parameter conversion : S ⇔ parameter Z, Y, H(ybrid) atau T(cascade), implementation in RF Transistor Modeling; Transmission Line : Distributed element : Propagation constant (γ, β and α), characteristic impedance (ZO), reflection coefficient, Γ and VSWR ; Bilinear transform : Smith Chart definition ; Impedance matching, shunt /seri : lumped, line-stub ; RF Amplifier : Stability Circle, Gain Description, Gain Circle; Simultaneous Conjugate Match, Small Signal Amplifier Design; Theory and Design of Low Noise Amplifier (LNA), Mixer techniques : Diode Mixer, Balanced Mixer (I-Q), Oscilator technique ; Mixed Signal : Baseband Processing (Introduksi), Digital Modulation / Demodulation, Digital Encoder/Decoder, NCO (Numerical Controlled Oscilator), DUC/DDC (Digital Up /Down Conversion), Digital Signal Processing ⇔ Analog : High Speed DAC/ADC, FIR Filter
Luaran (Outcomes)	Mindseting difference (treatment) of RF Electronics vs 'LF/DC' Electronics, Becoming knowledgeable in the 'mixed signal' and its purpose in digital wireless telecommunication; Understand concept and know-how of Scattering parameter (S-parameter); Becoming know-how to use S-parameter in acquiring other circuit/network parameters : Z, Y, H(ybrid) and T (cascade) and implementing in extracting RF Transistor (FET) equivalent circuit model; Understand the 'distributed element' nature of RF circuit line and origin of transmission line propagation with its Propagation constant ((γ, β) and characteristics impedance (ZO). Know how to interpret information in Smith Chart and determine impedance, Z (or Y) from Γ thru Smith Chart and vice-versa, as well as the standing wave (VSWR) and position of load impedance or other point to maxima dan minima. Understand stability condition and description of power gain of RF Amplifier. Become proficient in design procedure of RF Amplifier : from stability condition to plotting gain circle. Know how to implement simultaneous conyugate matching procedure. Knowledgeable noise property of amplifier and know how to plot noise circle on Smith Chart. Proficient in design of LNA (low noise amplifier). Gaining experience in the use microwave circuit simulation-design tool of Microwave circuit: Libra/Touchstone and Volterra series based (CNL2) as well as another circuit-graphic based design tool. Becomes knowledgeable on mixer techniques and circuit from diode mixing to balanced I-Q quad cold-FET: Diode Mixer. Understand condition and various oscilator microelectronic circuits ; Mixed Signal : Baseband Processing (Introduksi), Digital Modulation/Demodulation, Digital Encoder/Decoder, NCO (Numerical Controlled Oscilator), DUC/DDC (Digital Up /Down Conversion), Digital Signal Processing ⇔ Analog : High Speed DAC/ADC, FIR Filter ;Becomes knowledgeable on the purpose digital baseband processing. Understand basics of various digital modulation : QPSK, 16-QAM and 64-QAM . Understand basics of digital encoding/decoding. Knowledgeable of both techniques of NCO generation – LUT (look up Table) and CORDIC, as well as DUC (digital up conversion) and DDC (Digital Down Conversion). Becomes knowledgeable on purpose and digital process of RF-IF signal. Know the principle of DAC/ADC technical aspect : a Σ (sigma)-Δ(delta) ADC, Σ-Δ multistage converters and pipeline ADC. Knowledgeable on principle and various architectures of high speed DAC. Knowledgeable on FFT/IFFT, FIR Filtering
Matakuliah Terkait	EL2006 Electromagnetics — Prerequisite
	EL2007 Signal and System — Prerequisite
Kegiatan Penunjang	Tugas, Simulasi-Desain, Pengukuran S-parameter
Pustaka	G. Vendelin, A.M Pavio, U.L. Rohde, "Microwave Circuit Design using Linear and Non-linear Techniques'. Wiley Interscience (terbaru)

	Handout/copy excerpt modul disusun Dosen pengajar , dibagikan waktu kuliah.
	Sklar, Digital Communications: Fundamentals and Applications, 2nd ed., Prentice Hall, 2001 (pustaka alternatif)
Panduan Penilaian	PR/Tugas : 10 % , Mid-Term : 40 % , Final Design Project : 50%
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*SumberMateri*
1	Introduction , 2-port network	Lecture plan ; Introduction, 2-port network : Concept of reflection-transmission, S-parameter, Conversion of parameter Z, Y, H, T $\Leftrightarrow$ S, 2-port in Paralel, Seri and Cascade;	Mindseting difference (treatment) of RF Electronics vs 'LF/DC' Electronics, & knowledgeable on 'mixed signal' and its purpose in digital wireless telecommunication; Understand concept and know-how of Scattering parameter (S-parameter); Becoming know-how to use S-parameter in acquiring other circuit/network parameters : Z, Y, H(ybrid) and T (cascade	
2	2-port network : RF Transistor Modeling	Equivalent circuit of FET /Bipolar ; Derivation of S-parameter as function equivalent circuit elements – intrinsic model and extrinsic model of FET	Know how to implement the S-parameter data in extracting RF Transistor (FET) equivalent circuit model	
3	Transmission-line : Distributed Element	Transmission lines : µstrip,CPW, Wavecuide etc Distributed Element Model : describe ZO, propagation constant : $\gamma = \alpha + j\beta$, line impedance : Z = (Γ), Z = f (ZL ,βd), open/short stub, λ/4-transformer ; Standing wave : VSWR, Vmax, Vmin	Understand the 'distributed element' nature of RF circuit line, derivation of transmission line propagation constant (γ, β) and ZO ; Know how of VSWR and to find maxima-minima	
4	Smith Chart	Bilinear Transform – Derivation of mapping of Γ = f(Z) (Smith Chart); Usage of Smith Chart : $\Gamma(\beta d)$ Z $\Leftrightarrow$ Γ ,Y $\Leftrightarrow$ Γ, Y $\Leftrightarrow$ Z, VSWR, determine maxima-minima, open /short stub, λ/4-transformer	Knowledgeable origin of Smith Chart and mapping plane of Z (or Y) to Γ and vice-versa ; Know how to use Smith Chart to find VSWR and position of maxima dan minima.	
5.	Smith Chart (Impedance Matching)	Impedance Matching: Impedance matching on Smith Chart	Understand in using Smith Chart in impedance matching : using open/short stub, λ/4-transformer and	
6.	2-port RF Ampilifer –	RF Amplifier as 2-port : stability condition, Input/otput Stability (Stability circle)	Become proficient on determining stability condition and using Smith Chart to plot stability circle in determing input/output stability of RF Amplifier	
7	Power Gain ; Simultaneous Conjugate Match ;	Power transfer definition : Conjugate match ; Simultaneous Conjugate Match; Description of Power Gain ; Power gain Circle : gain mapping on Smith Chart ;	Description of power gain of RF Amplifier. : from stability condition to plotting gain circle Know how to implement simultaneous conyugate matching procedure	
8.	Mid-term	Mid-term exam		
9	Design of RF Amplifier	Design of Small Signal RF Amplifier ; Use of Design Tool : LIBRA/Touchstone, CNL2, ADS; Noise figure of RF Amplifier ; Design of Low Noise Amplifier (LNA); Plot of Noise Circle on Smith Chart	Become proficient in design of small signal RF Amplifier Knowledgeable noise property of amplifier and know how to plot noise circle on Smith Chart. Proficient in design of LNA (low noise amplifier). Gaining experience in the use microwave circuit simulation-design tool of Microwave circuit: Libra/Touchstone and Volterra series based (CNL2) as well as another circuit-graphic based design tool.	
10	Mixer ; Oscillator	Mixing theory , topology of diode mixer, balanced mixer, quad FET I-Q topology ; Oscillation condition, oscillator IC topology, PLL (Phase Lock Loop) : principle and working mechanism	Becomes knowledgeable on mixer techniques and circuit from diode mixing to balanced I-Q quad cold-FET: Diode Mixer. Understand condition and topology of microelectronic oscilalator circuits	
11	Baseband Processing;	Baseband processing : principle & techniques : Digital Modulation : QPSK, 16-QAM, 64-QAM, Digital Coding (Encoding, Decoding),	Acquiring intoroductory knowledge of Baseband Processing ; Knowledgeable on DigitalModulation : QPSK, 16-QAM, 64-QAM ; Knowledgeable on Digital Encoding ,	
12	NCO (Numerical Controlled Oscilator), Digital Frequency Conversion	Techniques of NCO : LUT (look up table), CORDIC, Digital Frequency Conversion : Digital Up Conversion (DUC), Digital Down Conversion (DDC)	Becomes knowledgeable NCO tmethods : LUT (Look up Table), CORDIC (Coordinate Rotation Digital Computer) ; Know how to digital up-down frequency conversion	
13.	Digital Signal Processing $\Leftrightarrow$ Analog	Digital to-from Analog Signal Processing techniques : High speed ADC /ADC; Principle of DAC/ADC : Σ (sigma)-Δ(delta), Σ-Δ multistage converters and pipeline ADC. Knowledgeable on principle & architectures of high speed DAC	Knowledgeable on Digital Signal Processing to and from Analog signal Becomes knowledgeable on purpose and digital process of RF-IF signal. Know the principle of DAC/ADC technical aspect : a Σ (sigma)-Δ(delta) ADC, Σ-Δ multistage converters and pipeline ADC. Knowledgeable on principle and various architectures of high speed DAC.	
14	FFT/IFFT , FIR Filter	FFT/IFFT (Fast Fourier Transform Method), Principle of FIR Filtering	Knowledgeable on FFT/IFFT conept and digital FIR Filtering	
15	Final Design Project (seminar)	Seminar of Final Design Project : Groups of student present their pre-design final project	Student groups presents their preparation and pre-design of their chosen topic of final design project	

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4121	***Bobot sks:*** 3	***Semester:*** 7	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Perancangan Sistem Embedded			
	Embedded System Design			
Silabus Ringkas	Pada kuliah ini diajarkan tentang sistem embedded, sistem real time, real time OS dan perancangan sistem embedded			
Silabus Lengkap	Peranan sistem embedded , sistem real time, model state chart, model data flow diagram , real time operating system, mikroprosesor 32 bit			
Luaran (Outcomes)	16. Menggunakan model state chart dan DFD untuk membuat software sistem embedded 17. Membuat software real time 18. Mampu menggunakan mutex dan semaphore pada RTOS 19. Mengatasi masalah shared data 20. Membuat fungsi reentrant 21. Menggunakan toolchain untuk prosesor ARM 22. Penjadwalan real time 23. Membuat sistem real time berbasis RTOS			
Matakuliah Terkait	EL3014 Sistem Mikroprosesor		Prasyarat	
	EL4122 Prakt.Peranc. Sistem Embedded		Bersamaan	
Kegiatan Penunjang	Praktikum Sistem Embedded			
Pustaka	Miro Samek, Practical UML Statecharts in C/C++, Elsevier, 2009			
	Peter Marwedel, "Embedded System Design			
	Kim Fowler, Misson-Critical And Safety-Critical Systems Handbook: Design And Development for Embedded Applications, Elsevier, 2010			
	Kim R. Fowler, What Every Engineer Should Know About Developing Real-Time Embedded Products, Taylor * Francis Group LLC, 2008			
	Daniel Lewis, Fundamentals of Embedded Software: Where C and Assembly Meet, Pearson			
	Richard Barry, Using the FreeRTOS Real Time Kernel - A Practical Guide - LPC17xx Edition.			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pengenalan		• Memahami peranan sistem embedded • Memahami sistem real time	
2	Pemodelan	State Chart	• Membuat hierarchical state chart • Membuat software berbasis state chart	[Miro Samek]
3		Data Flow Diagram	• Membuat DFD sebuah sistem • Membuat software berbasis DFD	[Yourdon]
4	Arsitektur Software		• Arsitektur super loop • Arsitektur foreground background • Arsitektur multithreading	[lewis]
5	Prosesor 32 bit	Pengenalan	• Pengenalan prosesor ARM • Tahu cara menggunakan prosesor 32 bit dan periferalnya	Datasheet ARM
6		Toolchain	• Membuat software pada prosesor 32 bit • Menggunakan toolchain untuk membuat software	
7	Real Time OS	Dasar RTOS	• Context Switching, semaphore, mutex, deadlock, priority inversion,	[Lewis]
8		Real Time Scheduler	• pre-emptive scheduler, • cooperative scheduler	[Lewis] [Marweddel]
9		Open Source RTOS	• Menggunakan open source RTOS untuk membuat sistem embedded	[Richard Barry]
10	Shared Resource	Shared Data	• Mengetahui konsep shared data / critical section / atomic code • Membuat software dengan shared data yang aman	[Lewis]
11		Reentrant Function	• Mengetahui terjadinya reentrancy • Teknik membuat fungsi yang reentrant	[Lewis]
12	Tools	Unit Test	• Menguji software dengan unit test	
		Source Code Management	• Melakukan manajemen pengembangan software dengan tools source tracking / revision control system	
13	Embedded System Project		• Merancang sistem real time dengan tools DFD & State Chart	
			• Pengujian Sistem	
14	Multicore Embedded System	Pengenalan	• Arsitektur Parallax Propeller • Bahasa SPIN	
15		Implementasi	• Toolchain Parallax • Scheduling	

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4238	***Bobot sks:*** 3	***Semester:*** 8	***KK / Unit Penanggung Jawab:*** Elektronika	***Sifat:*** Pilihan
Nama Matakuliah	Perancangan Sistem VLSI			
	VLSI System Design			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	This course has an objective to provide student with the capabily in designing Application Specific Integrated Circuits (ASICs). In this course, ASICs implementation is more focus on Semicustom Technology using CMOS Standard Cell. The course covers the introduction of various VLSI Technology Implementation and its design flow. The design process includes Architecture Design, Logic Synthesis, Placement and Routing, Design Testing and Verification. The design also involves back annotation and static timing analysis. In order to have complete understanding of design flow, the student will design medium size ASICs as a project.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	1. Participants understand the methodology of VLSI system design. 2. Participants understand the factors that affect the performance of VLSI systems. 3. Participants can design VLSI systems. 4. Participants can use HDL language for VLSI design systems. 5. Participants can work together in a group design. 6. Participant can implement their design in FPGA			
Matakuliah Terkait	EL2002 Sistem Digital		Prasyarat	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Digital Integrated Circuits (2nd Edition) by Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic			
	CMOS VLSI Design: A Circuits and Systems Perspective (3rd Edition) by Neil H.E. Weste and David Harris			
	Modern VLSI Design: System-on-Chip Design (3rd Edition) by Wayne Wolf (Link..)			
Panduan Penilaian	Assignments (20%), Midterm project (30%), Final project (50%)			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction to VLSI Technology	• Introduction, overview of VLSI Technology Advancement, Technology Scaling and Design Parameters • VLSI Technology Performance Parameters (Cost, Power Consumption, Speed, Size)	• Able to describe technology principles and its applications • Understand VLSI technology design parameters	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	VLSI Technology Implementation	• Full Custom and Semicustom Technology (Standard Cell Circuit and layout Design) • FPGA Technology	• Students will learn the implementation technology alternative in digital technology • Compare the benefit in performance and design cost • To introduce an FPGA technology and its design methodology	
3	• VLSI Technology Implementation • ASIC Design Flow	• FPGA Technology • Design Level and The Complete Design flow in ASIC from Design Specification to Layout	• To introduce an FPGA technology and its design methodology • To learn design flow of ASIC digital integrated circuits particularly using standard cell technology	
4	• ASIC Design Flow • ASIC Arithmetic Architecture Design	• Design Level and The Complete Design flow in ASIC from Design Specification to Layout • Adder and Substractor	To learn design flow of ASIC digital integrated circuits particularly using standard cell technology	
5	ASIC Arithmetic Architecture Design	• Multiplier and Divisor • Complex architecture (CORDIC)	To learn design flow of ASIC digital integrated circuits particularly using standard cell technology	
6	• ASIC Arithmetic Architecture Design • ASIC System Architecture Design	• Complex architecture (CORDIC) • Architecture Parameters and Performance (Latency, Throughput and Delay)	• To learn design flow of ASIC digital integrated circuits particularly using standard cell technology • Learn the principles and its application in ASIC design	
7	ASIC System Architecture Design	• Parallel and Pipeline Architecture • Architecture for Area	• Students will learn how to design a parallel and pipeline architecture, measure its performance, benefit and drawback of this architecture • Students will learn the architecture design technique to achieve small design size	
8	ASIC System Architecture Design	• Architecture for Area • Architecture for timing	• Students will learn the architecture design technique to achieve small design size • Students will learn the architecture design technique to achieve target design speed	
9	ASIC Physical Design	Logic Synthesis	• Develop capabilities in using modern CAD tools for complete standard cell based implementation -- initial design entry to layout. • Specify design constrain to achieve design target • Analyse the result for timing, area, DRC, ERC and LVS	
10	ASIC Physical Design	• Floorplaning • Placement and Routing	• Develop capabilities in using modern CAD tools for complete standard cell based implementation -- initial design entry to layout. • Specify design constrain to achieve design target • Analyse the result for timing, area, DRC, ERC and LVS	
11	Design Verification	• Static Timing Analysis • Design for Manufacturing	• Learn how to analyze the design timing • Consider the design for timing closure • Learn how to design test scenario for manufacturing test	
12	• Design Verification • RTL Design	• Design for Manufacturing • Behaviour Design	• Learn how to design test scenario for manufacturing test • Develop capabilities in using verilog HDL language for complete system design -- initial specifications to design implementation in FPGA.	
13	RTL Design	Combinational Design Principle and Guideline	Develop capabilities in using verilog HDL language for complete system design -- initial specifications to design implementation in FPGA	
14	• RTL Design • Project	• Sequential Design Principle and Guideline • Design for synthesis and Constraint	• Develop capabilities in using verilog HDL language for complete system design -- initial specifications to design implementation in FPGA • Provide students an opportunity to	

			practice team work and communicate their design experience orally and in writing.	
15	Project	Project Formulation, Design, Implementation and Verification	• Provide students an opportunity to practice team work and communicate their design experience orally and in writing. • Learn to design a complete system	

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4122	***Bobot sks:*** 1	***Semester:*** 7	***KK / Unit Penanggung Jawab:*** Prodi Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Praktikum Perancangan Sistem Embedded			
	Embedded System Design Laboratory			
Silabus Ringkas	Menguasai toolchain ARM 32 bit. Membuat aplikasi USB Membuat aplikasi real time tanpa OS Menguasai sistem operasi real time FreeRTOS Membuat aplikasi real time berbasis FreeRTOS Menguasai toolchain multicore embedded. Membuat aplikasi berbasis multicore embedded			
Silabus Lengkap	Menguasai toolchain ARM 32 bit. Membuat aplikasi real time tanpa OS Membuat aplikasi USB Mengukur waktu respon sistem real time Menguasai sistem operasi real time FreeRTOS Membuat aplikasi real time berbasis FreeRTOS Menguasai toolchain multicore embedded. Membuat aplikasi berbasis multicore embedded			
Luaran (Outcomes)	56.			
Matakuliah Terkait	EL4121 Perancangan Sistem Embedded		Bersamaan	
	EL3214 Prakt. Sistem Mikroprosesor		Prasyarat	
Kegiatan Penunjang				
Pustaka				
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)			
Catatan Tambahan				

Mg#	***Topik***	***Sub Topik***	***Capaian Belajar Mahasiswa***	***Sumber Materi***
1	Dasar ARM 32 bit	• Toolchain ARM 32 bit	Compile dan upload program ke ARM 32 bit	
		• Interfacing	Menguasai Interfacing digital dan analog pada ARM32	
2	Aplikasi real time tanpa OS	• Membuat aplikasi	Membuat aplikasi real time tanpa OS dengan model state chart	
		• Mengukur waktu respon sistem real time	Mengukur waktu respon sistem real time dengan alat ukur	
3	Aplikasi khusus	Membuat aplikasi USB	Menjalankan aplikasi berbasis USB pada board ARM32	
		Membuat aplikasi Flash	Membuat aplikasi yang membaca Flash memory dengan file system FAT / NTFS	
4	Sistem operasi real time FreeRTOS	•	Menguasai sistem operasi real time FreeRTOS	
5	Aplikasi real time berbasis RTOS	•	Membuat aplikasi real time berbasis FreeRTOS dengan model state chart	
6	Toolchain multicore embedded.	•	Compile dan upload program ke prosesor multicore Menguasai interfacing pada prosesor multicore	
7	Aplikasi berbasis multicore embedded	•	Membuat aplikasi real time berbasis prosesor multicore	

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4237	***Bobot sks:*** 3	***Semester:*** 8	***KK / Unit Penanggung Jawab:*** Elektronika	***Sifat:*** Pilihan
Nama Matakuliah	Teknologi IC			
	IC Technology			
Silabus Ringkas	Tinjauan material, divais, dan proses semikonduktor; penumbuhan kristal; oksidasi silikon; fotolitografi dan etsa; difusi dan implantasi ion; deposisi lapisan tipis; proses fabrikasi BJT dan MOSFET; integrasi proses; simulasi proses; manufaktur IC			
	Overview of semiconductor materials, devices, and process; crystal growth; silicon oxidation; photolithography and etching; diffusion and ion implantation; thin film deposition; BJT and MOSFET fabrication process; process integration; process simulation; IC manufacturing			
Silabus Lengkap	Tinjauan material, divais, dan teknologi proses semikonduktor. Kunjungan ke clean-room (lab) memahami proses fabrikasi N-MOSFET. Studi material fokus penumbuhan kristal dan wafer silikon. Teknologi proses silikon dasar; oksidasi silikon, fotolitografi, etsa, difusi, implantasi ion, deposisi lapisan tipis dan epitaksi. Fabrikasi chip rangkaian terintegrasi (IC) dengan teknologi BJT, MOSFET/MESFET, dan MEMS. Simulasi proses. Manufaktur IC menjelaskan uji elektrik, pengemasan, kontrol proses secara statistik, dan manufaktur yang diintegrasikan komputer. Trend dan tantangan masa depan tentang integrasi dan system-on-a-chip			
	Overview of semiconductor materials, devices & process technology. A clean-room (lab) visit to understand N-MOSFET fabrication process. Study of materials focus on silicon crystal growth and wafer. Basic silicon processess; silicon oxidation, photolithography, etching, diffusion, ion implantation, thin film deposition and epitaxy. Fabrication of integrated circuit (IC) chips using BJT, MOSFET/MESFET, and MEMS technologies. Process simulation. IC manufacturing describes electrical testing, packaging, statistical process control, and computer-integrated manufacturing. Future trends and challenges in integration and system-on-a-chip			
Luaran (Outcomes)	Setelah mengikuti kuliah ini dengan penuh, mahasiswa mampu : - memahami teknologi proses fabrikasi divais semikonduktor & rangkaian terintegrasi (IC), khususnya teknologi MOSFET dan bipolar. - melakukan simulasi proses semikonduktor. memahami manufaktur IC After fullly attending this course, students have capabilities : - to understand fabrication process technology of semiconductor devices and integrated circuit (IC), especially MOSFET and bipolar technology. - to do simulation of semiconductor processes. to understand IC manufacturing.			
Matakuliah Terkait	EL4129 Devais Semikonduktor		Prasyarat	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	G.S. May & S.M. Sze: Fundamentals of Semiconductor Fabrication, John Wiley & Son, 2004. ISBN. 9812-53-072-X			
	S.A. Campbell: The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 1996. ISBN. 0-19-510508-7			
	R. R. Tummala: Fundamentals of Microsystem Packaging, McGraw-Hill, 2001. ISBN. 0-07-137169-9			
Panduan Penilaian	Tugas/Kuis 10% Praktikum 20% UTS 30% UAS 40%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Overview of Semiconductor History, Material, Devices, & ICs.	Semiconductor history, material, devices, and ICs. Moore Law. NMOSFET-based IC Design & Fabrication Sequences.	Mengetahui sejarah penemuan transistor semikonduktor dan bagaimana kemajuan elektronika mengubah dunia. Mengenal bahan dan proses pembuatan divais semikonduktor.	May & Sze, Bab 1
2	NMOSFET Fabrication & Clean room visit	Wafer cleaning, field oxidation, lithography, etch, gate oxidation, source & drain diffusion, contact hole, metallization.	Memahami urutan fabrikasi transistor NMOS secara umum dan singkat. Mengunjungi fasilitas fabrikasi IC di lab.	www.
3	Crystal Growth and Silicon Wafer	Silicon crystal growth material, technique, dopant, and characterization.	Memahami teknik penumbuhan kristal silikon sehingga menghasilkan wafer silikon yang berkualitas.	May & Sze, Bab 2
4	Silicon Oxidation	Thermal oxidation process, impurity, properties, quality, and characterization.	Memahami teori, proses fabrikasi dan karakterisasi dari lapisan silikon dioksida berkualitas baik.	May & Sze, Bab 3
5	Pattern Transfer	Design software, maskmaking, photolithography & etching.	Menjelaskan tahap mulai perancangan hingga pemindahan pola kepada lapisan di permukaan substrat semikonduktor.	May & Sze, Bab 4 dan 5
6	Diffusion	Diffusion equation & profiles, evaluation of diffused layer, lateral diffusion.	Memahami teori, proses fabrikasi dan karakterisasi dari lapisan difusi tipe-N & tipe-P.	May & Sze, Bab 6
7	Ion Implantation	Ion distribution, stopping & channeling, implant damage and annealing.	Memahami teori, proses fabrikasi dan karakterisasi dari lapisan tipe-N dan tipe-P yang dibentuk dari teknik implantasi ion.	May & Sze, Bab 7
8	UTS			
9	Process Simulation (SUPREM)	Process modelling, simulation, and SUPREM exercise.	Mempelajari dan berlatih memodelkan suatu proses fabrikasi dengan simulator SUPREM-III.	May & Sze, Bab 2-9
10	Thin Film Deposition: Epitaxy, CVD & PVD	Epitaxial growth techniques: CVD&MBE, structures & defects, dielectric deposition, polysilicon deposition, and metallization.	Mengenal teknik deposisi lapisan tipis secara epitaksi, CVD dan PVD. Memahami kualitas lapisan tipis dan proses fabrikasi isolator, polysilicon gate dan lapisan metal pada IC.	May & Sze, Bab 8
11	Bipolar Transistor Fabrication	Epitaxial layer, burried layer, island isolation, base & emitter formation, resistor, diode & capacitor fabrication.	Mempelajari proses fabrikasi transistor bipolar mulai dari substrat silikon hingga terbentuk divais transistor berikut komponen resistor, dioda dan kapasitor.	May & Sze, Bab 9
12	Process Integration; Contact & Interconnect	Contact & interconnect, passive components, bipolar technology, MOSFET technology, MESFET technology, and MEMS technology.	Memahami pentingnya peran kontak dan interkoneksi agar divais yang difabrikasi menjadi rangkaian terintegrasi (IC). Memahami integrasi proses pada teknologi bipolar, MOSFET, MESFET, dan MEMS.	May & Sze, Bab 9
13	IC Manufacturing; IC Packaging	Single chip package, types, materials, process and properties. Multichip modules, type, design & technology	Mempelajari teknik pengemasan IC agar siap digunakan untuk berbagai aplikasi.	May & Sze, Bab 10 Tummala, Bab
14	IC Manufacturing; Test & Reliability	Electrical testing, statistical process control, experimental design, yield, and computer integrated manufacturing.	Mempelajari teknik proses kontrol, pengemasan dan pengujian IC agar siap digunakan untuk berbagai aplikasi.	May & Sze, Bab 10 Tummala, Bab
15	Future Trends and Challenges	Challenges for integration, System-on-a-Chip, etc.	Membahas peluang dan tantangan teknologi IC di masa depan.	May & Sze, Bab 11

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL4233	*3*	*8*	Sistem Kendali dan Komputer	Wajib

Nama Matakuliah	Dasar Sistem dan Kendali Cerdas
	Introduction to Intelligent Systems and Control
Silabus Ringkas	Intro to Inteligent Systems/Machines and Intelligent Control, Fuzzy Set Theory, Fuzzy rules, Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Control, Biological Neural Networks, Neuron Model and Computation, Perceptron, Supervised Learning, Adaptive Linear Networks, Multilayer Feedforward Neural Networks, BackPropagation, Applications of Intelligent Systems and Intelligent Control, Matlab Implementation, Robotics
	Intro to Inteligent Systems/Machines and Intelligent Control, Fuzzy Set Theory, Fuzzy rules, Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Control, Biological Neural Networks, Neuron Model and Computation, Perceptron, Supervised Learning, Adaptive Linear Networks, Multilayer Feedforward Neural Networks, BackPropagation, Applications of Intelligent Systems and Intelligent Control, Matlab Implementation, Robotics
Silabus Lengkap	Intro to Inteligent Systems and Intelligent Control, Characteristics of Intelligent Systems, Fuzzy Set Theory: basic definition and terminology, membership function(MF), fuzzy set theoritic operations, membership function formulation, MF of two dimension, Fuzzy Rules : fuzzy relations, fuzzy relation composition, fuzzy if-then rules, Fuzzy reasoning : compositional rule of inference, fuzzy reasoning, Fuzzy Inference Systems (FIS), Mamdani FIS model, Fuzzy Control : fuzzy control architecture and components, fuzzification, defuzzification, fuzzy rules, fuzzy inference mechanism, fuzzy control structure, fuzzy rules development, fuzzy embedded systems, fuzzy control applications, Biological Neural Networks, Neuron Model and Computation, Artificial Neural Networks (ANN) Topology, Perceptron, Supervised Learning, Perceptron Training, Adaptive Linear Networks, Delta Rule, Multilayer Feedforward Neural Networks (MFNN), MFNN forward computation, MFNN backward computation and Backpropagation, MFNN learning mechanism, ANN application in pattern recognitions and controls, Matlab implementation, Intro to mobile robots as a platform of intelligent systems
	Intro to Inteligent Systems and Intelligent Control, Characteristics of Intelligent Systems, Fuzzy Set Theory: basic definition and terminology, membership function(MF), fuzzy set theoritic operations, membership function formulation, MF of two dimension, Fuzzy Rules : fuzzy relations, fuzzy relation composition, fuzzy if-then rules, Fuzzy reasoning : compositional rule of inference, fuzzy reasoning, Fuzzy Inference Systems (FIS), Mamdani FIS model, Fuzzy Control : fuzzy control architecture and components, fuzzification, defuzzification, fuzzy rules, fuzzy inference mechanism, fuzzy control structure, fuzzy rules development, fuzzy embedded systems, fuzzy control applications, Biological Neural Networks, Neuron Model and Computation, Artificial Neural Networks (ANN) Topology, Perceptron, Supervised Learning, Perceptron Training, Adaptive Linear Networks, Delta Rule, Multilayer Feedforward Neural Networks (MFNN), MFNN forward computation, MFNN backward computation and Backpropagation, MFNN learning mechanism, ANN application in pattern recognitions and controls, Matlab implementation, Intro to mobile robots as a platform of intelligent systems
Luaran (Outcomes)	After completing this course students should able to : Compare crisp set and fuzzy set, Formulate fuzzy membership function, Understand continuous and discrete fuzzy set, Perform various fuzzy set operations, Compute fuzzy relation composition, Compute membership function of fuzzy rules, Understand fuzzy reasoning, Compute Fuzzy Inference System, Design fuzzy logic control, Determize fuzzy rules in fuzzy control, Program fuzzy concepts in Matlab, Understand neuron model, Compute neuron output given an input signal, perform perceptron training, understand adaptive networks, understand supervised learning, comprehend MFNN, perform MFNN forward computation, perform Backpropagation to update MFNN weights, comprehend fuzzy embedded control, program fuzzy control on microprocessor/microcontroller, understand the use of ANN in pattern recognition and in control, compare model based design with intelligent systems methods, use Fuzzy Logic Toolbox in Matlab, use Neural Networks Toolbox in Matlab, implement fuzzy inference system in embedded microcontroller/microprocessor, Understand basic pinciples of mobile robots
Matakuliah Terkait	EL3015 Sistem Kendali — Prasyarat
	EL3014 Sistem Mikroprosesor — Prasyarat
Kegiatan Penunjang	Assignment, programming and experimental project
Pustaka	Neurofuzzy and Soft Computing : A computational Approach to Learning and Machine Intelligence, J.S.R. Jang, C.T. Sun, E. Mizutani, Prentice-Hall, 1997
	Fuzzy Control and Identification, J. Lily, 2010
	Neural Networks : A comprehensive Foundation, S. Haykin, 2002
Panduan Penilaian	Tugas Ujian Tertulis Projek
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Intro to the course	• Course objective, course syllabus • Intro to intelligent systems • Characteristic of intelligent systems	• Understand basic principles of intelligent system method • Compare model based design and intelligent system method	Nurofuzzy and Soft-computing
2	Fuzzy set	• Basic definition and terminology • Membership function • Continuous and Discrete fuzzy set • Fuzzy set examples	• Understand fuzzy set • Characterize fuzzy set using membership function • Provide examples of fuzzy set • Compare crisp and fuzzy sets	Nurofuzzy and Soft-computing
3	Fuzzy set operations MF formulation	• Fuzzy intersection, fuzzy union, fuzzy complement, fuzzy subset • MF shape and formulation	• Perform fuzzy set operations • Formulate MF	Neurofuzzy and Soft-computing
4	Matlab programming of fuzzy concepts	• Matlab code of MF • Fuzzy set operation in Matlab	• Program MF in matlab • Program fuzzy set operation in Matlab	Neurofuzzy and Soft-computing
5	Fuzzy Relation and Fuzzy Rules	• Fuzzy relation • Fuzzy composition : max-min composition, max-product composition • Fuzzy rules • Linguistic variables	• Understand fuzzy relation and its MF • Perform fuzzy composition • Determine MF of fuzzy rule • Derived composite linguistic values from primary linguistic values	Neurofuzzy and Soft-computing
6	Fuzzy Reasoning and Its Matlab program	• Fuzzy reasoning • Matlab code for fuzzy relations, fuzzy rule composition	• Understand fuzzy reasoning • Program fuzzy relation, fuzzy rule composition in Matlab	Neurofuzzy and Soft-computing
7	Fuzzy Inference System (FIS)	• FIS with single antecedent • Mamdani FIS with multiple antecedents	• Compute FIS for single and multiple antecedents • Perform graphical representation of FIS with two-inputs and one output	Neurofuzzy and Soft-computing
8	Fuzzy Control	• Fuzzy control architecture • Fuzzy control components : fuzzification, defuzzification, fuzzy rules, fuzzy inference	• Comprehend fuzzy control • Compute defuzzification	Neurofuzzy and Soft-computing Fuzzy Control and Identification
9	Fuzzy Control Design and Matlab	• Fuzzy rules construction • Fuzzy control in Matlab	• Develop fuzzy rules based on ideal respons • Design fuzzy control using Matlab	Fuzzy Control and Identification
10	Fuzzy control design examples and fuzzy embedded control	• Fuzzy control applications • Fuzzy rules examples • Fuzzy embedded processor • Fuzzy programming	• Design fuzzy control • Understand fuzzy embedded processor/controller • Fuzzy programming on microcontroller	Fuzzy Control and Identification
11	Intro to Mobile robots	• Intro to mobile robots • Robot sensor • Robot control	• Undersand mobile robot • Understand robot sensor • Understand robot control	Mobile robot
12	Biological Neural Networks and neuron Model	• Biological neural networks • Neuron model and computation	• Understand basic principles of biological neural networks • Comprehend neuron model • Compute output of nuron model given input signal	Neural Networks : A Comprehensive Foundation
13	ANN learning	• Supervised learning • Perceptron model and perceptron learning algorithm • Adaptive linear networks • Matlab examples	• Understand supervised learning • Train perceptron to form classification • Comprehend adaptive linear networks and its learning algorithm	Neural Networks : A Comprehensive Foundation
14	Feedforward Multilayer Neural Networks and Backpropagation	• MLNN topology • MLNN forward computation • MLNN backward computation • Matlab examples	• Comprehend MLNN • Perform forward computation • Perform back-propagation	Neural Networks : A Comprehensive Foundation
15	ANN training with Backpropagation and Applications	• MLNN training • ANN applications in pattern recognition and in control	• Understand ANN training mechanism • Understand ANN applications	Neural Networks : A Comprehensive Foundation

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4124	***Bobot sks:*** 1	***Semester:*** 7	***KK / Unit Penanggung Jawab:*** Sistem Kendali & Komputer	***Sifat:*** Pilihan
Nama Matakuliah	Praktikum Sistem Kendali Digital			
	Digital Control System Lab			
Silabus Ringkas	Mahasiswa melakukan praktek realisasi sistem kendali digital pada sebuah motor DC dengan perangkat digital mikrokomputer (PC) dan mikroprosesor dan digital interfacing. Mahasiswa melakukan proses identifikasi motor DC, memilih periode sampling, melakukan simulasi sistem kendali analog/digital, merancang pengendali PID digital, merealisasikan pengendali dgnPC dan uP, kemudian membandingkan antara hasil perhitungan, simulasi, dan pengukuran langsung.			
	Modeling, Analysis, and Simulation of Digital Control System with MATLAB, Introduction to implementation equipment, Digital Speed Control System, Digital Position Control System.			
Silabus Lengkap	Menentukan model objek kendali, Analisis dengan Root Locus, Simulasi Sistem Kendali Digital dengan Simulink, Mengenal Perangkat Lunak Akusisi data, Mengenal Modular Sistem Servo MS150, H-Bridge dan pengkondisi sinyal, Pemakaian MS-150 sebagai alat praktikum Sistem Kendali Digital, Mengenal Mikrokontroler dan pemrogramannya, Kalibrasi alat untuk sistem kendali kecepatan Digital , Rangkaian sistem kendali kecepatan Digital, Sistem Kendali Kecepatan Digital lingkar tertutup dengan pengendali PID, Kalibrasi alat untuk sistem kendali posisi digital, Rangkaian sistem kendali posisi digital, Pengenalan sistem kendali posisi digital, Sistem Kendali Posisi dengan pengendali PID.			
	Model and validate plant transfer function Analyse control system using Root Locus, Simulate digital control system by Matlab-Simulink, Explain the characteristic of H-Bridge, Signal Conditioning, Modular Servo System MS-150, Implement digital control algorithm in microcontroller system, Calibrate the equipment for Digital Speed control system experiment, Implement the Digital speed control system and Digital posisiton control system using PID controller.			
Luaran (Outcomes)	Mahassiwa mampu mengaapresiasi perbedaan dan kemiripan antara teori, simulasi, dan realisasi sistem kendali digital Mahasiswa mampu merangkai dan mengukur kinerja sistem kendali digital dengan alat ukur Mahasiswa mampu menggunakan MATLAB dan Simulink untuk validasi perhitungan/rancangan sistem kendali digital Mahasiswa mampu merangkai sistem kendali digital menggunakan mikroprosesor maupun mikrokomputer			
Matakuliah Terkait	EL4123 Sistem Kendali Digital	Bersamaan		
	EL3215 Praktikum Sistem Kendali	Prasayarat		
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Modul Praktikum Sistem Kendali Digital [Pustaka Utama]			
	Katsuhiko Ogata, Discrete Time Control System, Second Edition, Prentise Hall 1995, [Pustaka Utama]			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Digital Control System Simulation	• Plant Transfer Function • Root Locus Analysis, • Digital Control System Simulation using Simulink	• Explain how to model the plant in digital transfer function • Apply Root Locus method to analyse digital control system • Simulate digital control system using Matlab-Simulink	Modul 1
2	Introduction to implementation equipment	• Introduction to Modular Servo System MS-150 • MS-150 as Digital Control System implementation Equipment	• Describe the type of Modular MS-150, H-bridge, and Signal conditioning • Describe input-output relation of Modular MS-150, H-bridge, and Signal conditioning	Modul 2
3	Implemention of the digital control algorithm using microcontroller system	• Introduction of microcontroller system as a digital controller • Interfacing microcontroller with H-bridge and signal conditioning • Programming microcontroller system • Implementation of digital control algorithm • Data communication with PC	• Explain the microcontroller system as a digital controller • Explain the interface between microcontroller with H-bridge and signal conditioning • Produce a microcontroller code as digital control implementation • Perform wiring circuit of digital control system • Set up data communication to PC	Modul 3
4	Data Acquisition	• Data Acquisition software • Data communication PC and microcontroller system • Data acquisition of digital control system	• Explain the data acquisition feature • Set up data communication between PC and microcontroller • Perform data transfer between PC and microcontroller	Modul 4
5	Implementation of Digital Speed Control System	• Equipment Calibration for Digital Speed Control System, • Circuit wiring of Digital Speed Control System, • Close Loop Digital Speed Control System with PID	• Prepare and calibrate the equipment for Digital speed control system implementation • Perform the circuit wiring of Digital speed control system • Implement the close loop Digital speed control system with PID controller	Modul 5
6	Implementation of Digital Posistion Control System	• Equipment Calibration for Digital Position Control System, • Circuit wiring of Digital Position Control System, • Introduction to Digital Position Control System, • Digital Position Control System with speed feedback, • Digital Position Control System using PID controller.	• Prepare and calibrate the equipment for Digital posistion control system implementation • Perform the circuit wiring of Digital position control system • Implement the close loop Digital position control system with PID controller	Modul 6
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KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4126	Bobot sks: 3	Semester: 7	***KK / Unit Penanggung Jawab:*** Sistem Kendali dan Komputer	***Sifat:*** Pilihan
Nama Matakuliah	Robotika			
	Robotics			
Silabus Ringkas	1) Pendahuluan:, 2) Sistem Mekanik Perpindahan Gerak Robot , 3)Model Kinematika maju dan kinematika balik , 4)Model Dinamik , 5)Perencanaan Gerak Robot : Manipulator dan Bergerak (roda dan kaki) , 6)Sensor Robot 7)Sistem Kendali Robot : Desain dan Implementasi			
	1) Introduction:, 2) Robot Locomotion, 3) kinematics and invers kinematics model, 4) Dynamic Model, 5) Robot Motion Planning : Manipulators and Mobile (wheel and leg), 6) Robot Sensors 7) Robot Control Systems: Design and Implementation			
Silabus Lengkap	**1) Pendahuluan**:Sejarah, Definisi, Tugas, aplikasi (industry, ;layanan), Tipe robot, komponen, **2) Sistem Mekanik Perpindahan Gerak robot** : tipe perpindahan, konsep link//bar-joint, Transmisi daya : roda gigi, tali/sabuk, rack-pinion, Sistem Aktuator : Elektrik, Pneumatic, hidrolik, Struktur Robot : Manipulator dan Robot Bergerak (roda dan kaki), Derajat Mobilitas , **3)Model Kinematika** : Konsep Kerangka Koordinat, Matriks rotasi Dasar, Vektor Translasi dan Transformasi Homogen, Kinematika dan Kinematika balik Robot manipulator (metoda Denavit Hatenberg) dan Robot Roda , **4)Model Dinamik** : Pendekatan melalui Representasi Model Kinematika, Pendekatan Geometri, studi kasus robot 3 DOF, **5)Perencanaan Gerak Robot** : Robot manipulator dan robot roda **6)Sensor Robot** : proprioceptive-exteroceptive, active-pasive, contact-non contact **7)Sistem Kendali Robot** : Desain dan Implementasi robot Roda atau kaki			
	1) Introduction: history, definition, task, applications (industrial, services), robot type, robot components, **2) Robot Locomotion** : type of movement, the concept of link/bar-joint, Power transmission : gear, belt, rack-pinion, Actuators: Electric, Pneumatic, hydraulic, Robot structure : Manipulator and mobile (wheels and legs), Degree of Mobility, **3) Kinematics Model** : coordinates Framework Concepts, Basic rotation matrix, translation and transformation of Homogeneous Vectors, kinematics and invers kinematics : robot manipulator (Denavit-Hatenberg method) and robot wheels, **4) Dynamics Model**: Lagrange Euler formulation : Model reprsentation approach through kinematics and geometry approach, case study 3 DOF robot **5) Robot Motion Planning**: manipulator and wheels, 6) robot Sensor: proprioceptive-exteroceptive, active-passive , contact- non-contact **7) Robot control systems**: design and implementation of robot wheels or legs			
Luaran (Outcomes)	Memahami definisi robot dan penggunaannya, mampu menjelaskan komponen pembentuk sistem robot,			
Matakuliah Terkait	EL3015 Sistem Kendali	Prasayarat		
	-	-		
Kegiatan Penunjang	Praktikum			
Pustaka	KS FU, RC Gonzales, CSG Lee, Robotics, Control, Sensing Vision and Inteligence, Mc. Graw-Hill, 1993 [utama]			
	A Lazinica, Robotics, Infinity Science Press, 2007 [Pendukung]			
	BM Dean, Mechanism and Robot Analysis using MATLAB, Springer Verlag, 2008 [Pendukung]			
Panduan Penilaian	Quiz 1/2/3 (20%), UTS (20%), UAS (30 %), Tugas dan Demonstrasi (30%)			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Pendahuluan	Sejarah, Aplikasi Robot, Definisi , Tugas dan fungsi Tipe Robot, Komponen sistem Robot (sub-sistem : mekanik, elektrik, elektronik, sensor, Pengendali utama, teach pendant)	mengetahui sejarah, memahami perspektif aplikasi robot, memahami definisi dan tugas dan fungsi robot Mengetahui tipe-tipe robot dan dan mampu menjelaskan komponen sistem robot	Sumber dari Internet (update) dan buku utama Bab 1
2	Sistem Mekanik Perpindahan Gerak Robot	Tipe perpindahan gerak, mekanisme dasar : 4 bar-link, link-joint, rack-pinion, pegas, Tipe roda gigi dan tali	Mampu menyusun konfigurasi link-bar untuk gerakan rotasi dan translasi Mampu menghitung energi static dan, kecepatan pada robot yang menggunakan sistem transmisi energi	Bab 2 buku pendukung
3	Sistem Mekanik Perpindahan Gerak Robot	Tipe link-joint, Tipe roda, tipe kaki, derajat manuverabilitas/ mobilitas/ pengemudian, tipe aktuator	Memahami mekanisme gerak manipulator, roda dan kaki. Mampu menghitung derajat manuverabilitas/ mobilitas/pengemudian dan komponen	Bab 2 buku pendukung
4	Model Kinematik	Konsep Kerangka Koordinat : Diam dan Bergerak, Matrik Rotasi dasar, Vektor Translasi, Rotasi dan Tranlasi terhadap Sumbu sembarang, Transformasi Homogen	Mampu menghitung posisi dan orientasi Kerangka Koordinat relatif terhadap Kerangka Koordinat yang lain yang mengalami rotasi dan translasi	Bab 3 Buku Utama, dan Simulasi Matlab Buku Pendukung
5	Model Kinematik	Model Kinematik dengan Metoda Denavit Hatenberg untuk Robot Manipulator, Perhitungan Model Kinematik Robot bergerak tipe roda	Mampu menurunkan model transformasi homogen setiap lengan (link) robot manipulator relative terhadap lengan tetangganya dan model kinematik robot bergerak tipe roda	Bab 3 Buku Utama, dan Simulasi Matlab Buku Pendukung
6	Model Dinamika	Model Dinamika Robot manipulator dengan Pendekatan Lagrange-Euler melalui model kinematik dan geometri	Mampu menurunkan model dinamika robot manipulator 3 DOF	Bab 4 Buku Utama, dan Simulasi Matlab Buku Pendukung
7	Model Dinamika	Model dinamika Robot Bergerak tipe roda	Mampu menurunkan model	Bab 4 Buku Utama, dan Simulasi Matlab Buku Pendukung
8	Perancangan Gerak Robot	Trayektori pergerakan joint dan ujung lengan manipulator (Cartesian)	Memahami cara menurunkan profil posisi, kecepatan dan percepatan joint melalui pendekatan polynomial 4-3-4	Bab 5 Buku Utama,
9	Perancangan Gerak Robot	Trayektori pergerakan robot bergerak (roadmap, cell decomposition, potensial field, bug algotihm)	Mampu menurunkan tryektori pergerakan robot bergerak dengan pendekatan roadmap, cell decomposition dan bug algorithm	Bab 3 Buku Pendukung
10	Sistem Sensor	Berbagai sensor untuk keperluan robot	Mengetahui prinsip kerja dari berbagai jenis sensor yang digunakan dalam robot	Bab 6 buku Pendukung
11	Desain Sistem Kendali Robot	Rangkain pengkondisi sinyal untuk sensor, rangkaian penggerak (drive) actuator (stepper, DC), sistem kendali berbasis microcontroller	Memahami pembuatan rangkain elektronik/elektronika daya untuk Sesnor dan Aktuator	Bahan Kuliah Sisitem Intrumentasi Kendali, Bahan Kuliah Sistem Kendali, Bahan Kuliah Sistem Mikroprosesor
12	Desain Sistem Kendali Robot	Desain pengendali PID dan implementasi dalam sistem digital (mikrokontroller)	Memahami implementasi Sistem kendali dalam sebuah mikrokontroller	Bahan Kuliah Sisitem Intrumentasi Kendali, Bahan Kuliah Sistem Kendali, Bahan Kuliah Sistem Mikroprosesor
13	Presentasi Tugas Individu	Presentasi didepan kelas tentang ide robot untuk sebuah aplikasi	Mampu menjelaskan ide yang disampaikan, merinci komponen pembentuk sistem robot dan implikasi terhadap penggunaan robot tersebut	
14	Presentasi Tim (Fungsional)	Presentasi Global dan tugas masing personil dalam pembuatan robot	Mampu bekerjasama dan berperan dalam sebuah tim, mampu menjelaskan aspek teknis dari system yang dibangun	
15	Demonstrasi Tim (Lomba)	Demonstrasi Tim yang dilombakan dalam sebuah arena	Mampu membuat aplikasi sederhana dan melakukan trouble shooting	

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4123	***Bobot sks:*** ***3***	***Semester:*** ***7***	***KK / Unit Penanggung Jawab:*** Sistem Kendali & Komputer	***Sifat:*** Pilihan
Nama Matakuliah	Sistem Kendali Digital			
	Digital Control Systems			
Silabus Ringkas	Kuliah ini menjelaskan analisis dan desain kendali digital, dengan perhatian pada proses pencuplikan sinyal pada sistem , proses pengukuran sinyal, analisis kendali diskrit melalui model konvensioanal (transformasi Z), analisis kendali diskrit melalui model variabel-keadaan (moderm), rancangan kendali melalui pendekatan klasik dan modern, implementasi kendali dengan perangkat keras dan perangkat lunak			
	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)	Mahasiswa mempunyai kemampuan analisis dan perancangan sistem kendali digital linier dengan menggunakan methoda klasik dan methoda modern (pengenalan), dan mengimplementasikan pengendali digital pada perangkat keras dan perangkat lunak			
Matakuliah Terkait	EL3015 Sistem Kendali		Prasyarat	
	EL3010 Pengolahan Sinyal Digital		Prasyarat	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Ogata, Katsuhiko. ; Discrete-Time Control Systems; 3rd Edition, Prentice-Hall			
	Houpis and Lamont, , Digital Control Systems : Theory, Hardware and Software, Prentice-Hall, 1992			
	Phillips, Digital Control System Analysis and Design, Prentice-Hall, 1995			
	Leigh, J. R.; Appplied Digital Control : (theory, design, and implementation); 2nd Edition, Prentice Hall, New York, 1992			
Panduan Penilaian	UTS (40%), UAS (30%), Tugas (20%), Lainnya (10%)			
Catatan Tambahan	Strategi Pedagogi dan Pesan Untuk Pengajar: Pada minggu pertama kuliah, dosen harus mampu menggali penguasaan mahasiswa terhadap analisis pada sistem kendali (sistem kendali klasik, kontinyu), yang diperoleh pada kedua mata kuliah prasyarat: Sistem Kendali dan pengolahan sinyal digital (DSP). Perlu disampaikan ulang penguasaan mahasiswa terhadap hal itu akan melancarkan penguasaan materi pada kuliah sistem kendali digital, yang dapat dipandang perluasaan dan kekhususan sistem kendali. Bila dipandang perlu berikan ulang pokok-pokok materi yang sudah diperoleh pada kedua kuliah prasyarat, kemudian dilakukan kuis dan lakukan pembahasan hasil. (sebagai modal awal). Demo dan praktikum menggunakan prosesor. mikrokontroler atau mikrokomputer diperlukan untuk			

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	**Pendahuluan dan Kerangka Umum Sistem Kendali Digital**	Perkembangan kendali digital. Otomasi Industri Dan Sistem kendali Digital. Terapan sistem kendali digital di industri, sistem elektromekanik Kerangka kendali digital dan hubungan dengan kendali analog.	●Mahasiswa mampu menyebut kan perkembangan kendali digital, kaitannya dengan komputer (prosesor) digital dan aplikasinya di industri/ lainnya ●Mahasiswa dapat menyebutkan /menggambarkan perbedaan, keunggulan, dan lainnya, antara kendali digital dengan analog. ●Mahasiswa dapat menyebutkan hubungan antara Sistem kendali digital, sistem digital, sistem data diskrit, sistem waktu diskrit, sistem waktu kontinyu.	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	**Pendahuluan dan Kerangka Umum Sistem Kendali Digital** (lanjutan)	Terminologi sistem data kontinyu, sistem Data diskrit, sistem Data digital. Sistem kendali digital dan komputer digital.	●Mahasiswa dapat menggambar kan sinyal kontinyu, diskrit, analog dan sinyal digital. ●Mahasiswa dapat menjelaskan terjadinya data diskrit dan data digital dari sinyal analog kontinyu(tercuplik) ●Mahasiswa dapat menggambar kan model diagram (aliran sinyal) dan diagram simulasi sistem kendali digital, dan mampu menyebutkan peran komponennya ●Mahasiswa dapat menggambar kan model diagram perangkat keras komputer digital (mikro kontroler) dalam kaitannya dengan sistem kendali digital	
3	**Sistem Linier (Kon tinyu / Diskrit) dan Proses Pencuplikan Sinyal.**	Persamaan Differensial Sistem linier tak berubah waktu Persamaan Differesi Proses pencuplikan sinyal domain waktu Pencuplik ideal dan Modulasi impuls. (deret fourier dan transformasi fourier)	●Mahasiswa dapat menuliskan dan menurunkan persamaan differensial sistem linier dari suatu sistem fisik.. ●Mahasiswa dapat mencari solusi persamaan differensial Sistem linier. (metoda klasik) ●Mahasiswa dapat menurunkan persamaan differensi sistem linier dari persamaan deret. ●Mahasiswa dapat menurunkan persamaan differensi sistem linier dari persamaan differensial. (sinyal tercuplik) ●Mahasiswa dapat menghitung solusi persamaan defference sistem linier (metoda klasik) ●Mahasiswa dapat menjelaskan terjadinya proses pencuplikan pada sistem kendali digital. ●Mahasiswa dapat menggambar kan diagram blok sistem kendali sinyal tercuplik ●Mahasiswa dapat menggambar kan bodeflot sinyal modulasi impuls. ●Mahasiswa dapat menyebut	

			kan akibat pencuplikan suatu sinyal pada domain waktu atau domain frekuensi. ●Mahasiswa dapat menghitung batasan waktu pencuplik	
4	**Sistem Linier (Kontinyu / Diskrit) dan Proses Pencuplikan Sinyal**. (lanjutan)	Transformasi Laplace sinyal termodulasi impuls Rekontruksi Sinyal diskrit. Komponen pencuplik (elektronika), konversi data digital	●Mahasiswa dapat membedakan transformasi laplace sinyal pembawa dengan sinyal termodulasi, serta sifatnya ●Mahasiswa dapat menyebutkan syarat rekontruksi sinyal. ●Mahasiswa dapat menuliskan bentuk umum rekontruksi melalui ekspansi derer Taylor. ●Mahasiswa dapat menggambar kan model rekontruksi sinyal melalui pencuplik dan Hold. ●Mahasiswa dapat menyebutkan komponen konversi sinyal kontinyu ke digital /sebaliknya.	
5	**Teknik Transformasi Z Dan Model Sistem Diskrit**	Sinyal Diskrit dan transformasi Z. Sifat-sifat Transformasi Z. Fungsi Pindah Sistem DalamTransformasi Z. Model Sistem Kendali Diskrit. Modifikasi Transformasi Z	●Mahasiswa dapat menuliskan hubungan antara sinyal diskrit dan Transformasi Z. ●Mahasiswa dapat menuliskan hubungan antara Transformasi Fourier, Laplace dan transf. Z. ●Mahasiswa dapat menuliskan sifat-sifat transformasi Z ●Mahasiswa dapat menurun kan sebagian sifat transformasi Z ●Mahasiswa dapat mengguna kan sifat-sifat Transformasi Z ●Mahasiswa dapat menurunkan fungsi pindah sistem dari pers. differensi dan pers.differensial. ●Mahasiswa dapat menurunkan fungsi pindah sistem dalam transformasi Z dari fungsi pindah transformasi Laplace. ●Mahasiswa dapat menggambar kan diagram blok sistem kendali diskrit. ●Mahasiswa dapat menurunkan fungsi pindah dalam bentuk transf. Z, dari diagram blok. ●Mahasiswa dapat menurunkan fungsi pindah dalam bentuk transformasi Z, sistem hibrida. ●Mahasiswa mampu mengguna kan transformasi z (termodifikasi) untuk menghitung nilai antara sampling	
6	**Teknik Transformasi Z Dan Model Sistem Diskrit**	*AnalisisStabilitas MelaluiTransformasi Z.*	●Mahasiswa dapat menyebutkan hubungan stabilitas sistem dengan akar karakteristik. ●Mahasiswa dapat menentukan stabilitas sistem dari letak pole	

			sistem. (akar karakteristik) ●Mahasiswa dapat menentukan stabilitas sistem dari fungsi pindah transformasi Z. ●Mahasiswa dapat menghitung letak akar dari sistem model diagram blok. ●Mahasiswa mampu mengguna kan metoda matrik untuk menguji stabilitas sistem	
7	**Analisis Kendali Diskrit**	. Unjuk kerja dan karakteristik sistem kendali digital Sistem digital simpal terbuka. Tanggapan waktu sistem, Gangguan pada sistem, Fungsi Pindah Sistem digital simpal tertutup. Metoda diagram blok, metoda graf aliran sinyal	●Mahasiswa mampu menyebut kan *atribut* unjuk kerja sistem kendali digital dan membanding kannya dengan unjuk kerja sistem kendali analog. ●Mahasiswa mampu menyebut kan kelemahan sistem terbuka. ●Mahasiswa mampu menjelaskan dengan perhitungan/analisisi sinsitivitas sistem ●Mahasiswa dapat menurunkan fungsi pindah dalam bentuk E*(S) dan transformasi Z dari sistem hibrida simpal tertutup. ●Mahasiswa dapat menghitung akar karakteristik sistem kendali hibrida (analog/digital)	
8	**Analisis Kendali Diskrit** (lanjutan)	. Stabilitas sistem kendali digital simpal tertutup.	●Mahasiswa dapat menentukan kestabilan sistem simpal tertutup melalui funfsi pindah ●Mahasiswa dapat menggambar kan dalam domain waktu sistem stabil dan sistem tidak stabil. ●Mahasiswa mampu mengguna kan metoda matrik untuk menguji stabilitas sistem	
9	**Analisis Kendali Diskrit** (lanjutan)	. Analisis Kesalahan Keadaan Tunak. Keadaan tunak terhadap sinyal tetap DC Tipe sistem Keadaan tunak terhadap sinusoidal Contoh sistem keadaan Tunak	●Mahasiswa adapat menyebut kan definisi kesalahan keadaan tunak. ●Mahasiswa adapat menurunkan persamaan simpangan (kesalahan) keadaan tunak. dari sistem simpal tertutup ●Mahasiswa dapat menghitung koefisien kesalahan keadaan tunak. ●Mahasiswa dapat	
10	**Analisis Kendali Diskrit** (lanjutan)	. Analisis Melalui Root-Locus. Metoda domain Frekuensi	●Mahasiswa dapat menggambar kan Root locus dari sistem linier waktu diskrit. ●Mahasiswa dapat meyebutkan hubungan letak akar pd diagram komplek dengan response waktu ●Mahasiswa dapat menurunkan fungsi pindah bentuk transf. Z, dari sistem hibrida. ●Mahasiswa dapat menyebut kan hubungan transformasi Z dengan bidang W. ●Mahasiswa dapat menggambar kan locus pada	

		Transformasi Bilinier. Solusi Numerik Persamaan Differensial.	bidang W. ●Mahasiswa dapat menentukan stabilitas dari diagram bid.W. ●Mahasiswa dapat menghitung letak akar dari model diagram blok ●Mahasiswa dapat menurunkan transformasi bilinier. ●Mahasiswa dapat menggunakan transformasi bilinier untuk menentukan kestabilan sistem. ●Mahasiswa dapat menyebutkan hubungan ketelitian solus pers. differensial dngan waktu sampel ●Mahasiswa dapat mengguna kan methoda numerik untuk menghitung solusi persyama an differensi	
11	**.Prinsif Pengukuran dan Konversi Sinyal.**	Sistem Konversi Sinyal. Konversi Digital-to-Analog Konversi Analog-to-Digital. Pengukuran sinyal dan sensor. Aktuator dan Power Amplifier. Interface Input-Output Sinyal	●Mahasiswa dapat menyebut kan hubungan antara pengukur an sinyal dan konversi sinyal serta prinsif konversi. ●Mahasiswa dapat menggam barakan letak konverter D/A pada kendalian . ●Mahasiswa dapat menggam barkan rangkaian dan diagram konverter D/A. ●Mahasiswa dapat menggam barkan letak konverter A/D pada kendalian. ●Mahasiswa dapat menggam barkan rangkaian dan diagram konverter A/D. ●Mahasiswa dapat menyebut kan prinsif- pengukuran. ●Mahasiswa dapat menyebut kan jenis sensor untuk pengu kuran besaran-besaran fisis. ●Mahasiswa dapat menghitung besaran pengkondisi sinyal ●Mahasiswa dapat menyebut kan prinsif aktuator dan (driver). ●Mahasiswa dapat menyebut kan jenis power amplifier. ●Mahasiswa dapat menggam barkan power amplifier metoda pengaturan level tegangan.. ●Mahasiswa dapat menggam barkan power amplifier methoda mengaturan lebar pulsa (PWM) ●Mahasiswa dapat menyebut kan jenis interface I/O. ●Mahasiswa dapat menggam barkan rangkaian interface dalam sistem kontrol digital	
12	Perancangan dan Analisis Kendali	Perancangan Kendalil Digital Melalui Sinyal	●Mahasiswa dapat membuat diagram sistem untuk kendali	

	Digital. (Methoda klasik) Membahas methoda perancangan sistem kontrol digital melalui pendekatan sinyal waktu diskrit dan pendekatan sinyal waktu kontinyu.	diskrit. Kendali dan Kompensasi Digital Perancangan Kendalil Digital Melalui Sinyal kontinyu. Kendali dan Kompensasi Digital	digital melalui diskritisasi. ●Mahasiswa dapat menghitung nilai konstanta P. I. D. dengan mempertimbangkan kriteria. ●Mahasiswa dapat menggambar kan diagram blok dan rangkaian untuk kompensator P.I.D dngan komponen perangkat keras. ●Mahasiswa dapat menuliskan Allgoritma kompensator P.I.D. yang diperoleh dari perhitungan. ●Mahasiswa dapat menghitung kompensasi melalui metoda approksimasi Ziegler-Nichols. ●Mahasiswa dapat menghitung parameter kompensasi melalui Algoritma Kalman. ●Mahasiswa dapat menghitung parameter Kompensasi Dead-Beat ●Mahasiswa dapat menggambar kan diagram blok sistem kendali pendekatan sinyal kontinyu. ●Mahasiswa dapat menyebutkan hubungan analisis numerik dengan pendekatan pengolah sinyal digital untuk persamaan Integrator dan differensiator. ●Mahasiswa dapat menghitung paramater kompensator pada kendali sistem waktu kontinyu ●Mahasiswa dapat menuliskan Algoritma Kendali dengan menterjemahkan persamaan PID dari rancangan kriteria kriteria sistem kontinyu. ●Mahasiswa dapat menghi tung parameter Kompensasi pendekatan analisis numerik	
13	.Implementasi Dan Algoritma Sistem Kendali Digital. Membahas metoda perancangan sistem kontrol digital melalui pendekatan sinyal waktu diskrit dan pendekatan sinyal waktu kontinyu.	Logika Kendalil. Arsitektur Komputer Untuk Kendalil. Realisasi Pengendali Kendali dengan unit delay	●Mahasiswa dapat menuliskan Algoritma komputer dari logika kendali. ●Mahasiswa dapat menggam bar kan diagram aliran untuk suatu hukum-hukum kendali. ●Mahasiswa dapat menggam barkan arsitektur perangkat keras suatu komputer. ●Mahasiswa dapat menyebut kan hubungan arsitektur komputer dengan interface I/O sistem kendalil. ●Mahasiswa dapat menggam barkan rangkaian dengan unit delay untuk merealisasikan hukum-hukum kendali. ●Mahasiswa dapat menyebut kan methoda direk, methoda paralel dan methoda faktorisasi untuk kompensator. ●Mahasiswa dapat menggambar kan rangkaian dengan unit delay untuk	

		Rancangan Perangkat Lunak Pada Sistem Kendalil Sistem Operasi Waktu-nyata Kendali Digital	merealisasikan hukum-hukum kendalil. ●Mahasiswa dapat menghitung parameter kompensasi dengan menggunakan unit delay. ●Mahasiswa dapat menyebut kan perangkat lunak yang dapat dipakai untuk realisasi kendali. ●Mahasiswa dapat membuat diagram untuk realisasi kendalil. ●Mahasiswa dapat menuliskan program komputer untuk realisasi kendali. ●Mahasiswa dapat menghitung waktu program untuk suatu algoritma Kendali diskrit. ●Mahasiswa dapat mengguna kan pasilitas program yang berhubungan dengan algoritma waktu nyata	
14	Model Diskrit Variabel-Keadaan. Membahas methoda analisis sinyal diskrit melalui ungkapan variabel-keadaan, serta mempelajari sifat-sifat matrik keadaan dan matrik transision	Representasi Variabel-Keadaan Sistem Linier. Solusi waktu persamaan Variabel-keadaan. Diskritisasi Persamaan Variabel-keadaan kontinyu Transformasi Matrik Variabel-keadaan. Kontrolabilitas dan Observabilitas Sistem.	●Mahasiswa dapat menurunkan pers variabel-keadaan sistem fisis dari parameter komponen, persamaan differens, dan persamaan deret. ●Mahasiswa dapat menghitung solusi waktu persamaan keadaan dengan methoda transformasi Z. ●Mahasiswa dapat menghitung matrik transisi sistem diskrit ●Mahasiswa dapat membuat persamaan-variabel keadaan diskit dari persamaan variabel-keadaan kontinyu ●Mahasiswa dapat menyebutkan metoda transformasi variabel keadaan dan sarat transformasi ●Mahasiswadapat menggunakan metoda transformasi variabel keadaan sistem diskrit. ●Mahasiswa dapat menggunakan operasi matrik untuk memeriksa kontrolabilitas sistem ●Mahasiswa dapat mengguna kan operasi matrik untuk memeriksa observabilitas sistem	
15	Mehoda Perancangan Kondali Melalui Variabel keadaan. Membahas methoda perancangan kendali melalui variabel-	Kerangka Sistem Terkandali Relokasi Pole Sistem simpal tertutup	●Mahasiswa dapat menurunkan matrik variabelkeadaan kanonik ●Mahasiswa dapat membuat diagram blok bentuk kanonik. ●Mahasiswa dapat membuat diagram blok sistem umpan balik variabel keadaan. ●Mahasiswa dapat menyebutkan hubungan antara letak pole dengan tanggapan waktu.	

	keadaan (methoda modern), serta mempelajari penggunaan observer dan aplikasi methoda variabel keaadan pada rancangan regulatorr	Umpan-balik Variabel keadaan Kerangka Sistem Teramati Umpan balik Output dan Disain Observer Regulator dan observer	●Mahasiswa dapat menyebut kan hubungan perubahan pole dengan perubahan konstanta . ●Mahasiswa dapat menyebut kan hubungan perubahan pole dengan perubahan konstanta . ●Mahasiswa dapat menghitung parameter kompensasi umpan balik variabel keadaan. ●Mahasiswa dapat membuat algoritma komputer untuk kendalil ●Mahasiswa dapat menyebut kan hubungan pengukuran dengan umpan balik v. keadaan ●Mahasiswa dapat menggambar kan kerangka sistem teramati dan hubungannya dengan kompensator. ●Mahasiswa dapat menggarbar kan hubungan pengukuran dengan umpan balik v. keadaan ●Mahasiswa dapat menurun kan pers. obserever dengan sinyal kontrol dan output.. ●Mahasiswa dapat menghitung parameter full-state observer. ●Mahasiswa dapat menghitung paramater minimal observer. ●Mahasiswa dapat membuat algoritma dan membuat bahasa komputer sebuah observer ●Mahasiswa dapat menurunkan persamaan obserever dengan sinyal kontrol dan output.. ●Mahasiswa dapat menghitung parameter full-state observer. ●Mahasiswa dapat menghitung paramater minimal observer. ●Mahasiswa dapat membuat algoritma dan membuat bahasa komputer sebuah observer	

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Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL4234	*3*	*8*	Sistem Kendali & Komputer	Wajib

Nama Matakuliah	Sistem Kendali Multivariabel
	Multivariable Control System
Silabus Ringkas	Pendahuluan SKM, Representasi sistem dalam ruang status, Solusi Persamaan Status Tidak berubah terhadap waktu, Keterkendalian, Keteramatan, Penempatan Kutub, Perancangan SKM dengan umpan balik status, Perancangan Pengamat Status, Simulasi SKM, Implementasi SKM dengan umpan balik status dan Pengamat Status.
	Introduction to Multivariable Control System, State Space Representation of System, Solving The Time-Invariant State Equation, Controllability, Observability, Pole Placement, Design of Multivariable Control System with State Feedback, Observer Design, Multivariable Control System Simulation, Implementation of Multivariable Control System with Observer and State Feedback
Silabus Lengkap	Perspektif Perancangan dengan Ruang Status, Kelebihan SKM, Representasi Sistem dalam bentuk Kanonik: Terkendali-Teramati-Diagonal-Jordan, Transformasi Model, Solusi Persamaan Status Homogen, Solusi Persamaan Status Non-Homogen, Keterkendalian , Keteramatan, Pemilihan Lokasi Kutub, Perancangan SKM dengan Penempatan Kutub, Penentuan Matrik Penguatan Umpan Balik dengan Matrik Transformasi-Metode Substitusi Langsung-Formula Ackermann, Perancangan Sistem Servo, Perancangan Pengamat Status Penuh, Perancangan Pengamat Status Minimum, Perancangan Kompensator, Perancangan Regulator, Perancangan Sistem Penjejak, Simulasi SKM dengan umpan balik status, Simulasi Pengamat Status Penuh dan Pengamat Status Minimum, Implementasi SKM dengan umpan balik status dan Pengamat Status.
	A Perspective on State Space Design, Advantages of State Space, State Space Representation of System in Canonical Form: Controllable-Observable-Diagonal-Jordan Form, Transformation of System Model, Solution of Homogeneous State Equation, Solution of Non-Homogeneous State Equation, Controllability, Observability, Selection of Pole Location, Pole Placement Design, Determination of Matrix K Using Transformation Matrix-Direct Substitution-Ackermann's Formula, Design of Servo System, Design of Full Order Observer, Design of Minimum Order Observer , Compensator Design, Regulator Design, Tracking System Design, Control System with State Feedback Simulation, Simulation of Full Order Observer and Minimum Order Observer, Implementation of Multivariable Control System with Observer and State Feedback
Luaran (Outcomes)	Explain A Perspective on State Space Design and Advantages of State Space, Represent a System in Canonical Form: Controllable-Observable-Diagonal-Jordan Form, Compute the transformation of System Model, Compute the Solution of Homogeneous State Equation, Compute the Solution of Non-Homogeneous State Equation, Determine the Controllability of a system, Determine the Observability of a system, Select of Pole Location for good design, Apply the design Method with Pole Placement, Determine of Matrix K Using Transformation Matrix-Direct Substitution-Ackermann's Formula, Apply the design procedure of Servo System, Apply the design procedure of Full Order Observer, Apply the design procedure of Minimum Order Observer , Apply the design procedure of regulator system, Apply the design procedure of tracking System , Simulate the Multivariable Control System with State Feedback , Simulate the Full Order Observer and Minimum Order Observer, Implement the Multivariable Control System with Observer and State Feedback
Matakuliah Terkait	EL3015 Sistem Kendali — Prasyarat
Kegiatan Penunjang	Tugas, Simulasi, dan Praktikum
Pustaka	Katsuhiko **Ogata**, Modern Control Engineering, Fifth Edition, Prentice Hall 2010 (Pustaka Utama)
	Gene F. **Franklin**, J. David Powell, Abbas Emami-Naeini, Feedback Control of Dynamic Systems, 6th Edition, Prentice Hall 2010 (Pustaka Utama)
	Richard C. **Dorf** and Robert H.Bishop, Modern Control System, Pearson Prentice Hall 2008 (Pustaka Pendukung)
	Dingyu Xue, YangQuan Chen, Derek P. Atherton, Linear Feedback Control: Analysis and Design with MATLAB , The Society for Industrial and Applied Mathematics 2007 (Pustaka Pendukung)
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction to Multivariable Control System	• A Perspective on State Space Design • Advantages of State Space	Explain A Perspective on State Space Design and Advantages of State Space	Franklin, Ogata
2	State Space Representation of System	• Canonical Controllable Form • Canonical Observable Form • Canonical Diagonal Form • Canonical Jordan Form	Represent a System in Canonical Form: Controllable-Observable-Diagonal-Jordan Form	Franklin, Ogata
3	State Space Representation of System	Transformasi Model: • From a canonical form to another, • From Transfer Function to State space, and vice versa.	• Transform System Model from a canonical form to another • Transform model from transfer function to state space • Transform model from state space to transfer function	Franklin, Ogata
4	Solving The Time-Invariant State Equation	• Solution of Homogeneous State Equation • Solution of Non-Homogeneous State Equation	• Compute the solution of Homogeneous State Equation • Compute the solution of Non-Homogeneous State Equation	Ogata
5	Controllability	• Controllability Concept • Controllability Matrix	• Explain controllability Concept • Compute Controllability Matrix • Determine system controllability	Ogata
6	Observability	• Observability Concept • Observability Matrix	• Explain Observability Concept • Compute Observability Matrix • Determine system Observability	Ogata
7	Pole Placement	• Selection of Pole Location • Pole Placement Design • Determination of Matrix K Using Transformation Matrix-Direct Substitution-Ackermann's Formula	• Explain how to select of Pole Location • Apply Pole Placement Design Procedure • Determine the Matrix K Using Transformation Matrix-Direct Substitution-Ackermann's Formula	Franklin
8	Pole Placement	• Design of Servo System • Regulator Design • Tracking System Design	• Apply design procedure of Servo System • Design a regulator system • Design a tracking System	Ogata
9	Observer Design	• Design of Full Order Observer • Design of Minimum Order Observer	• Apply design procedure of Full Order Observer • Apply design procedure of Minimum Order Observer	Ogata
10	Compensator Design	Design Gain State Feedback with observer	Apply design procedure of Gain State Feedback with observer	Ogata
11	Multivariable Control System Simulation	• Control System with gain state feedback simulation • Observer simulation	• Simulate a Control System with gain state feedback • Simulate an observer	Ogata
12	Multivariable Control System Simulation	• Analysis the simulation result • Reporting	• Analyze the simulation result • Make a simulation report	Ogata
13	Implementation of Multivariable Control System with Observer and State Feedback	• Hardware and software for implementation • Model validation	• Prepare the hardware and software for implementation • Compare model and plant to validate the model	Ogata
14	Implementation of Multivariable Control System with Observer and State Feedback	• Control System with gain state feedback implementation • State observer implementation	• Implement a control System with gain state feedback • Implement a state observer	Ogata
15	Implementation of Multivariable Control System with Observer and State Feedback	• System Integration • Implementation result Analysis • Reporting	• Integrate hardware and software • Analyse the implementation result • Make the implementation report	Ogata

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Program Studi Sarjana Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4127	***Bobot sks:*** **3**	***Semester:*** 7	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Arsitektur dan Komputasi Parallel			
	Parallel Computing and Architecture			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	[*Uraian ringkas silabus matakuliah dalam Bahasa Inggris (maksimum 30 kata)*]			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	This is an introductory course for undergraduate students on the broad subject of parallel computing. It begins with an overview of the field focusing on the convergence of many diverse architectural approaches around the communication architecture. Increasingly, parallel processing is being seen as the only cost-effective method for the fast solution of computationally large and data-intensive problems. The emergence of inexpensive parallel computers such as commodity desktop multiprocessors and clusters of workstations or PCs has made such parallel methods generally applicable, as have software standards for portable parallel programming. This sets the stage for substantial growth in parallel software. Message Passing Interface (MPI), POSIX threads and OpenMP have been selected as programming models and the evolving application mix of parallel computing is reflected in various examples throughout the course.			
Luaran (Outcomes)	1. Master basic concepts of parallel computing. 2. Master parallel algorithm design and analysis. 3. Be familiar with performance evaluation for parallel programs. 4. Be familiar with problem solving on parallel computers. 5. Be exposed to several advanced parallel computers, such as, GPU, Cray T94, SGI Origin 2000, and cluster of PCs.			
Matakuliah Terkait	EL2008 Problem Solving with C	Prasyarat		
	[*Kode dan Nama Matakuliah*]	[*Prasyarat, bersamaan, terlarang*]		
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	A. Grama, V. Kumar, A. Gupta, An Introduction to Parallel Computing, Design and Analysis of Algorithms, 2nd edition, Addison Wesley, 2003 (Pustaka utama) [1]			
	P. S. Pacheco, Parallel Programming with MPI, Morgan Kaufmann, 1997 (Pustaka utama) [2]			
	B. Chapman, G. Jost, Ruud van der Pas, Using OpenMP, MIT Press, 2007 (Pustaka utama) [3]			
	M. J. Quinn, Parallel Computing in C and OpenMPI , McGraw-Hill, 2004 (Pustaka pendukung)			
	W. Gropp, E. Lusk, A. Skjellum, Using MPI, MIT Press, 1999 (Pustaka pendukung)			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction	Why and what is parallel/distributed computing? History, Power, Parallel vs. Distributed, Fault tolerance, Concurrency, non-determinism, locality Crosscutting and Broader topics: power, locality; cluster, grid, cloud, p2p, web services	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[1] Chapter 1
2	Parallel Architectures	• Taxonomy • Data versus control parallelism:SIMD/Vector, Pipelines, MIMD, Multi-core, Heterogeneous • Shared versus distributed memory:SMP (buses), NUMA (Shared Memory), Message passing (no shared memory): Topologies		[1] Chapter 2
3	Parallel Architectures	Memory hierarchy, caches, and Power Issues		[1] Chapter 2
	Algorithm Parallel and distributed models and complexity	Cost of computation and Scalability: Asymptotics, time, cost, work		[1] Chapter 2 [1] Chapter 3
4	Algorithm Parallel and distributed models and complexity	Cost of computation and Scalability: Cost optimality, speedup, efficiency, space, power		[1] Chapter 3
	Algorithm Parallel and distributed models and complexity	Notions from scheduling: Dependencies, task graphs, work, makespan		[1] Chapter 3
5	Algorithmic	• Divide and conquer, Recursion • Series-parallel composition		[1] Chapter 3
6	Algorithmic Problems	• Communication: broadcast, multicast, reduction, parallel prefix, scatter/gather • Synchronization: atomic operations, mutual exclusion, barrier synchronization; race condition		[1] Chapter 4
7	Algorithmic Problems	Specialized computations: Representative sample from among matrix product, transposition, convolution, and linear systems		[1] Chapter 9
8	Midterm			
9	Algorithmic Problems	Sorting, selection		[1] Chapter 11
10	Parallel Programming paradigms	• By the target machine model: Shared memory, Distributed Memory, Client-Server, Hybrid • By the control statements: Task/thread spawning, SPMD, Data parallel, Parallel loop		[1] Chapter 6,7
11	Parallel programming notations	Shared memory notations: language extensions, compiler directives/pragma, libraries		[1] Chapter 6,7 [2] Chapter2
12	Parallel programming notations	Shared memory notations: language extensions, compiler directives/pragma, libraries		[1] Chapter 6,7 [3] Chapter 3
13	Parallel programming	MPI and CUDA		[2] and [3]

	notations			
	Semantics and correctness issues	Synchronization: shared memory programs with critical regions, producer-consumer; mechanism for concurrency (monitors, semaphores, etc.)		[1] Chapter 5
14	Semantics and correctness issues	Concurrency defects: deadlock (detection, prevention), race conditions (definition), determinacy/indeterminacy in parallel programs		[1] Chapter 5
15	Performance issues	• Computation: static and dynamic scheduling, mapping and impact of load balancing on performance • Data: Distribution, Layout, and Locality, False sharing, Data transfer • Performance metrics: speedup, efficiency, work, cost; Amdahl's law; scalability		[1] Chapter 5
16	Final Exam			

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Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4235	***Bobot sks:*** ***3***	***Semester:*** ***8***	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Arsitektur Sistem Komputer II			
	Computer System Architecture II			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	[*Uraian ringkas silabus matakuliah dalam Bahasa Inggris (maksimum 30 kata)*]			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	Computer architects have been striving to improve performance ever since the first stored program computer was designed half a century ago. Superscalar execution is one of the techniques in this avenue and most modern microprocessors employ superscalar issue and other instruction-level parallelism techniques to enhance their performance. In the simplest words, superscalar processors are processors that can issue more than one instruction per cycle. This course examines the tradeoffs and design considerations in the design of superscalar or instruction level parallel (ILP) microprocessors. The course will also explore other current architectural approaches to improve performance			
Luaran (Outcomes)	This course is intended to introduce concepts of modern processors design. The course will also stress on processor design and implementation using VHDL.			
Matakuliah Terkait	EL3011 Computer System Architecture		Prasyarat	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	John L. Hennessy and David A. Patterson , Computer Organization and Design: The Software Hardware Interface, Morgan Kaufmann Publishers, Fourth Edition, 2009. [P&H]			
	John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamental of Superscalar Processor, McGraw Hill, 2005. [MPD]			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction	Review of MIPS	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[P&H] Ch2
2	Review	Review of Single Cycle and Pipeline		[P&H] Ch4
3	MIPS Implementation	VHDL MIPS Pipeline		
4	Cache	VHDL Cache Implementations		
5	Modern Pipeline	Pipeline and its limitations		[MPD] Ch2
6	Memory and I/O	Modern Memory and I/O to support Modern pipeline		[MPD] Ch3
7	SuperScalar	Concepts		[MPD] Ch4
8	Midterm			
9	SuperScalar	Instruction Flows, Branch predictions, Tomasulo Alg, OoO		[MPD] Ch5
10	SuperScalar	Register and memory data flow		[MPD] Ch5
11	Examples	Intel Pentium P6 and PowerPC 620		[MPD] Ch6
12	Multi Threads			[MPD] Ch11
13	Multiprocessor	SMP and Cache and Coherence		[MPD] Ch11
14	Multicore & GPU	GPU architecture		[MPD] Ch11
15	Power Aware Architecture			
16	Final Exam			

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Sekolah Teknik Elektro dan Informaatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*KK / Unit Penanggung Jawab:*	*Sifat:*
EL4120	*3*	*7*	Teknik Komputer	Wajib

Nama Matakuliah	Jaringan Komputer
	Computer Network
Silabus Ringkas	OSI 7 and TCP/IP layer models, Circuit and Packet Switching, Medium Access Control, Error Control Techniques (ARQ), Routing and Dijkstra's Algorithm, flow/congestion control, IEEE 802.11 (WLAN), Bluetooth, Wireless Sensor Network (WSN).
	OSI 7 and TCP/IP layer models, Circuit and Packet Switching, Medium Access Control, Error Control Techniques (ARQ), Routing and Dijkstra's Algorithm, flow/congestion control, IEEE 802.11 (WLAN), Bluetooth, Wireless Sensor Network (WSN).
Silabus Lengkap	Basics of the TCP/IP layer model, as well as the OSI 7 layer model, Tasks of physical, datalink layers, Tasks of network layer, Tasks of transport and application layers, Circuit switching, Packet switching, MAC mechanisms (Aloha, Slotted Aloha, TDMA, FDMA), Random access and scheduled MAC mechanisms, Error control techniques in telecommunication networks, ARQ techniques, Link state and distance vector routing, Dijkstra's shortest path algorithm, Flow/congestion control, IEEE 802.11a, 802.11b and 802.11g: Architecture, MAC Sublayer, Physical Layer, WLAN Security Features, Bluetooth Architecture, Bluetooth Layers: Radio layer, Baseband layer, L2CAP, Other upper layers, Sensor technology and WSN applications review, Wireless technology for distributed sensor networks including protocol and layers, Clustering techniques in WSN, Routing in WSN.
	Basics of the TCP/IP layer model, as well as the OSI 7 layer model, Tasks of physical, datalink layers, Tasks of network layer, Tasks of transport and application layers, Circuit switching, Packet switching, MAC mechanisms (Aloha, Slotted Aloha, TDMA, FDMA), Random access and scheduled MAC mechanisms, Error control techniques in telecommunication networks, ARQ techniques, Link state and distance vector routing, Dijkstra's shortest path algorithm, Flow/congestion control, IEEE 802.11a, 802.11b and 802.11g: Architecture, MAC Sublayer, Physical Layer, WLAN Security Features, Bluetooth Architecture, Bluetooth Layers: Radio layer, Baseband layer, L2CAP, Other upper layers, Sensor technology and WSN applications review, Wireless technology for distributed sensor networks including protocol and layers, Clustering techniques in WSN, Routing in WSN.
Luaran (Outcomes)	Understand the basics of the TCP/IP layer model, as well as the OSI 7 layer model, Explain tasks of every layer in TCP/IP model, Understand the difference between circuit and packet switching, Be able to analyze different MAC mechanisms (Aloha, Slotted Aloha, TDMA, FDMA) and understand their pros and cons, Learn the differences between random access and scheduled MAC mechanisms, Understand how error control is implemented in telecommunication networks, Mathematically model various error control schemes, Understand the difference between link state and distance vector routing, Learn to carry out Dijkstra's shortest path algorithm in a given network, Tell how IEEE 802.11a networks function, and how they differ from 802.11b networks, List the advantages and disadvantages of an IEEE 802.11g network, Compare low-speed and high-speed WLANs, Explain basic and enhanced WLAN security features, Understand the bluetooth architecture for several applications, Explain the tasks of every bluetooth layer, Learn WSN network design, Learn appropriate data dissemination protocols and model links cost, Learn suitable medium access protocols and radio hardware
Matakuliah Terkait	EL3016 Sistem Komunikasi — Prasyarat
Kegiatan Penunjang	Tugas dan Simulasi
Pustaka	Tanenbaum and Wetherall, Computer Networks, 5th ed., Prentice Hall, 2010 (pustaka utama)
	Peterson and Davie, Computer Networks, 5th ed., Morgan Kaufmann, 2011 (pustaka utama)
	Forouzan, Data Communication and Networking, 5th ed., McGraw-Hill Science/Engineering/Math, 2012 (pustaka alternatif)
	Garcia and Widjaja, Communication Networks, 2nd ed., McGraw-Hill Science/Engineering/Math, 2003 (pustaka alternatif)
	Karl and Willig, Protocols and Architectures for Wireless Sensor Networks, 1st ed., Wiley, 2007
	Faludi, Building Wireless Sensor Networks: with ZigBee, XBee, Arduino, and Processing, 1st ed., O'Reilly Media, 2010
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	OSI 7 and TCP/IP layer models	• Basics of the TCP/IP layer model, as well as the OSI 7 layer model • Tasks of physical, datalink layers	• Understand the basics of the TCP/IP layer model, as well as the OSI 7 layer model • Explain tasks of physical, datalink layers	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
2	OSI 7 and TCP/IP layer models	Tasks of network layer	Explain tasks of network layer	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
3	OSI 7 and TCP/IP layer models	Tasks of transport and application layers	Explain tasks of transport and application layers	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
4	Circuit and Packet Switching	• Circuit switching • Packet switching	Understand the difference between circuit and packet switching	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
5	Medium Access Control	MAC mechanisms (Aloha, Slotted Aloha, TDMA, FDMA)	Be able to analyze different MAC mechanisms (Aloha, Slotted Aloha, TDMA, FDMA) and understand their pros and cons	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
6	Medium Access Control	Random access and scheduled MAC mechanisms	Learn the differences between random access and scheduled MAC mechanisms	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
7	Error Control Techniques (ARQ)	• Error control techniques in telecommunication networks • ARQ techniques	• Understand how error control is implemented in telecommunication networks • Mathematically model various error control schemes	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
8	Routing and Dijkstra's Algorithm, flow/congestion control	• Link state and distance vector routing • Dijkstra's shortest path algorithm	• Understand the difference between link state and distance vector routing • Learn to carry out Dijkstra's shortest path algorithm in a given network	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
9	Routing and Dijkstra's Algorithm, flow/congestion control	Flow/congestion control	Understand the flow/congestion control	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
10	IEEE 802.11 (WLAN)	IEEE 802.11a, 802.11b and 802.11g: Architecture	• Tell how IEEE 802.11a networks function, and how they differ from 802.11b networks • List the advantages and disadvantages of an IEEE 802.11g network • Compare low-speed and high-speed WLANs	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
11	IEEE 802.11 (WLAN)	• IEEE 802.11a, 802.11b and 802.11g: MAC Sublayer, Physical Layer	• Tell how IEEE 802.11a networks function, and how they differ from 802.11b networks	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer

		• WLAN Security Features	• List the advantages and disadvantages of an IEEE 802.11g network • Compare low-speed and high-speed WLANs • Explain basic and enhanced WLAN security features	Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
12	Bluetooth	• Bluetooth Architecture • Bluetooth Layers: Radio layer, Baseband layer, L2CAP, Other upper layers	• Understand the bluetooth architecture for several applications • Explain the tasks of every bluetooth layer	• Tanenbaum and Wetherall, Computer Networks • Peterson and Davie, Computer Networks • Forouzan, Data Communication and Networking • Garcia and Widjaja, Communication Networks
13	Wireless Sensor Network (WSN)	• Sensor technology and WSN applications review • Wireless technology for distributed sensor networks including protocol and layers	• Learn WSN network design • Learn appropriate data dissemination protocols and model links cost • Learn suitable medium access protocols and radio hardware	• Karl and Willig, Protocols and Architectures for Wireless Sensor Networks • Faludi, Building Wireless Sensor Networks: with ZigBee, XBee, Arduino, and Processing
14	Wireless Sensor Network (WSN)	Clustering techniques in WSN	• Learn WSN network design • Learn appropriate data dissemination protocols and model links cost • Learn suitable medium access protocols and radio hardware	• Karl and Willig, Protocols and Architectures for Wireless Sensor Networks • Faludi, Building Wireless Sensor Networks: with ZigBee, XBee, Arduino, and Processing
15	Wireless Sensor Network (WSN)	Routing in WSN	• Learn WSN network design • Learn appropriate data dissemination protocols and model links cost • Learn suitable medium access protocols and radio hardware	• Karl and Willig, Protocols and Architectures for Wireless Sensor Networks • Faludi, Building Wireless Sensor Networks: with ZigBee, XBee, Arduino, and Processing

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Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah:	*Bobot sks:*	*Semester:*	*Unit Penanggung Jawab:*	*Sifat:*
EL4128	**3**	**7**	Program S1 Teknik Elektro	Pilihan

Nama Matakuliah	Perancangan Sistem Operasi
	Operating System Design
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]
	This course is is a programming-intensive OS class. The core experience is writing a small Unix-inspired OS kernel, in C with some x86 assembly language, which runs on a PC hardware. The core topics will stress on design principles which covers abstractions, processes and resources at computer systems. This course will also covers thread, processes, scheduling synchronization, memory allocation, virtual memory, system file, and inter-process communication. We will use MINIX (MINIX 3) which is a streamlined, simplified new edition remains the only operating systems text to first explain relevant principles, then demonstrate their applications using a Unix-like operating system as a detailed example. It has been especially designed for high reliability, for use in embedded systems, and for ease of teaching.
Luaran (Outcomes)	Students can design and implement various parts of an Operating System.
Matakuliah Terkait	EL2008 Pemecahan masalah dengan C — Prasyarat
Kegiatan Penunjang	
Pustaka	Andrew S. Tanenbaum, Operating Systems Design & Implementation, 3rd Ed, Prentice-Hall Inc.,2006.
	James L. Peterson & Abraham Silbershatz, Operating System Concepts, Addison Wesley, 2004.
	Andrew S. Tanenbaum, Modern Operating Systems, 2nd Ed, Prentice-Hall Inc.,2001.
	MINIX manual, www.minix3.org
Panduan Penilaian	Homework 20% Exam 70% Quiz 10%
Catatan Tambahan	

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction; OS History; OS Concepts			
2	System Calls; OS structure			
3	Processes, Threads models, usage and implementation Interprocess Communication, IPC problems			
4	Scheduling			
5	Overview of Processes & Implementation of Processes in MINIX3			
6	The System Task in MINIX 3, The Clock Task in MINIX 3			
7	I/O Hardware and Software, Deadlocks			
8	MidTerm exam			
9	I/O in MINIX 3 Ram Disks, Disks, Terminals			
10	Virtual Memory, Page replacement Algorithm, Design issue of Paging Systems			
11	Segmentation, The MINIX 3 Process Manager			
12	Files, Directories, File System Implementation			
13	File System Security, Implementation File System in MINIX 3			
14	Example of File Systems			
15	Security			

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4236	***Bobot sks:*** ***3***	***Semester:*** ***8***	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Perangkat Lunak Jaringan			
	Network Software Engineering			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	Introduction of the concept of programming a computer network architecture and the introduction of the concept of application programming using sockets. This course is a course introducing the concept of programming a computer network architecture and also the introduction of the concept of application programming using sockets. In these subjects will be studied in detail the implementation of TCP / IP protocol. Students will gain experience from making a network application. Students at the end of the class will have the ability to create a network application programs.			
Luaran (Outcomes)	Students can design and implement applications to the network.			
Matakuliah Terkait	EL4120 Computer Networks		Prasyarat	
Kegiatan Penunjang				
Pustaka	W. Richard Stevens, "Unix Network Programming", Prentice Hall, 1990			
	W. Richard Stevens and Gary R. Wright, "TCP/IP Illustrated Volume 2: The implementation", Addison Wesley, 1995			
Panduan Penilaian	Homework 20% Exam 50% Quiz 10% Project 20%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction and ISO layering architecture			
2	Review of TCP/IP			
3	Unix Programming Model			
4	Interprocess Communications			
5	Sockets			
6	Sockets			
7	Transport Layer interface			
8	MidTerm exam			
9	Library Routines (Berkeley Sockets)			
10	Routing, TCP and UDP Sockets			
11	Client Server Programming			
12	Network Security			
13	Game Programming Example			
14	Game Programming Example			
15	Game Programming Example			

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2043	***Bobot sks:*** 3	***Semester:*** 3 or 4	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Layanan
Nama Matakuliah	Elektronika Industri			
	Industrial Electronics			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	Students learn wide topics of industrial electronics, from analog of AC and DC passive and active components and related circuits to digital electronics of basic digital circuits and microprocessor, from fundamental concepts to their applications in instrumentation systems and amplifiers using op-amp and transistors. It also covers magnetic Circuits using transformers, and electric drives based on DC Machines and Generators.			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	Introduction to industrial electronics; Fundamental Concepts; Resistive Circuits; Ideal Op-Amp; Inductance and Capacitance; Transient analysis of 1st and 2nd Order Circuits; Sinusoidal Steady State Analysis; AC Power and 3-Phase Circuits; Logic Circuits & Microprocessor; Isntrumentation Systems; Diode, Bipolar and Filed Effect Transistors; Magnetic Circuits and Transformers; DC Machines and Generators			
Luaran (Outcomes)	Analyse analog circuits consists of AC and DC passive and active components Understand basic digital circuits and microprocessor Understand fundamental concepts and their applications in instrumentation systems and amplifiers using op-amp and transistors Analyse magnetic Circuits using transformers Understand the principle of DC Machines and Generators and their uses in industrial electric drives			
Matakuliah Terkait	FI1201 Fisika IIA		Prasyarat	
	[*Kode dan Nama Matakuliah*]		[*Prasyarat, bersamaan, terlarang*]	
Kegiatan Penunjang				
Pustaka	Electrical Engineering: Principles and Applications, 5/E, Allan R. Hambley, Prentice Hall, 2011			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	UTS 30% UAS 30% PR 20% Kuis 20%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Fundamental Concepts	[*Uraikan sub-topik bahasan*]	• Recognize interrelationships between electrical engineering and other fields of science and engineering. • List the major subfields of electrical engineering. • List several important reasons for studying electrical engineering. • Define current, voltage, and power, including their units. • Calculate power and energy and determine whether energy is supplied or absorbed by a circuit element. • State and apply Kirchhoff's current and voltage laws. • Recognize series and parallel connections. • Identify and describe the characteristics of voltage and current sources. • State and apply Ohm's law. • Solve for currents, voltages, and powers in simple circuits.	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Resistive Circuits		• Solve circuits (i.e., find currents and voltages of interest) by combining resistances in series and parallel. • Apply the voltage-division and current-division principles. • Solve circuits by the node-voltage technique. • Solve circuits by the mesh-current technique. • Find Thévenin and Norton equivalents and apply source transformations. • Apply the superposition principle. • Draw the circuit diagram and state the principles of operation for the Wheatstone bridge.	
3	Ideal Op-Amp		• List the characteristics of ideal op amps. • Identify negative feedback in op-amp circuits. • Use the summing-point constraint to analyze ideal op-amp circuits that have negative feedback. • Select op-amp circuit configurations suitable for various applications. • Use op amps to design useful circuits. • Identify practical op-amp limitations and recognize potential inaccuracies in instrumentation applications. • Work with instrumentation amplifiers. • Applyintegrators, differentiators, and activefilters.	
4	Inductance and Capacitance		• Find the current (voltage) for a capacitance or inductance given the voltage (current) as a function of time. • Compute the capacitances of parallel-plate capacitors. • Compute the energies stored in capacitances or inductances. • Describe typical physical construction of capacitors and inductors and identify parasitic effects. • Find the voltages across mutually coupled inductances in terms of the currents.	
5	Transient analysis of 1st and 2nd Order Circuits		• Solve first-order RC or RL circuits. • Understand the concepts of transient response and steady-state response. • Relate the transient response of first-order circuits to the time constant. • Solve RLC circuits in dc steady-	

			state conditions. • Solve second-order circuits. • Relate the step response of a second-order system to its natural frequency and damping ratio	
6	Sinusoidal Steady State Analysis		• Identify the frequency, angular frequency, peak value, rms value, and phase of a sinusoidal signal. • Determine the rms value of any periodic current or voltage. • Solve steady-state ac circuits, using phasors and complex impedances. • Compute power for steady-state ac circuits. • Find Thévenin and Norton equivalent circuits. • Determine load impedances for maximum power transfer. • Discuss the advantages of three-phase power distribution. • Solve balanced three-phase circuits.	
7	AC Power and 3-Phase Circuits			
8	Midterm Exam			
9	Logic Circuits		• State the advantages of digital technology over analog technology. • Understand the terminology of digital circuits. • Convert numbers between decimal, binary, and other forms. • Use the Gray code for position and angular sensors. • Understand the binary arithmetic operations used in computers and other digital systems. • Interconnect logic gates of various types to implement a given logic function. • Use Karnaugh maps to minimize the number of gates needed to implement a logic function. • Understand how gates are connected together to form flip-flops and registers.	
10	Microprocessors		• Identify and describe the functional blocks of a microcomputer. • Select the type of memory needed for a given application. • Understand how microcomputers ormicrocontrollers can be applied in your field of specialization. • Identify the internal registers and their functions for the 68HC11 microcomputer. • List some of the instructions and addressing modes of the 68HC11. • Write simple programs, using the 68HC11 instruction set.	
11	Instrumentation System		• Describe the operation of the elements of a computer-based instrumentation system. • Identify the types of errors that may be encountered in instrumentation systems. • Avoid common pitfalls such as ground loops, noise coupling, and loading when using sensors. • Determine specifications for the elements of computer- based instrumentation systems such as dataacquisition boards.	
12	Diode		• Understand diode operation and select diodes for various applications. • Use the graphical load-line technique to analyze nonlinear circuits. • Analyze and design simple voltage-regulator circuits. • Use the ideal-diode model and piecewise-linear models to solve circuits. • Understand various rectifier	
13	Bipolar and Filed Effect Transistors		• Understand bipolar junction transistor and MOSFET operation in amplifier circuits. • Use the load-line technique to	

			analyze simple amplifiers and understand the causes of nonlinear distortion. • Use large-signal equivalent circuits to analyze BJT circuits. • Analyze bias circuits. • Use small-signal equivalent circuits to analyze BJT and FET amplifiers. • Select an amplifier configuration appropriate for a given application. • Compute the performance parameters of several FET/BJT amplifier configurations. • Understand the basic operation of CMOS logic gates •	
14	Magnetic Circuits and Transformers		• Understand magnetic fields and their interactions with moving charges. • Use the right-hand rule to determine the direction of the magnetic field around a current-carrying wire or coil. • Calculate forces on moving charges and currentcarrying wires due to magnetic fields. • Calculate the voltage induced in a coil by a changingmagnetic flux or in a conductor cutting through a magnetic field. • Use Lenz's law to determine the polarities of induced voltages. • Apply magnetic-circuit concepts to determine the magnetic fields in practical devices. • Determine the inductance and mutual inductance of coils, given their physical parameters. • Understand hysteresis, saturation, core loss, and eddy currents in cores composed of magnetic materials such as iron. • Understand ideal transformers and solve circuits that include transformers. • Use the equivalent circuits of real transformers to determine their regulations and power efficiencies.	
15	DC Machines and Generators		• Select the proper motor type for various applications. • State how torque varies with speed for various motors. • Use the equivalent circuit for ac & dc motors to compute electrical and mechanical quantities. • Use motor nameplate data. • Understand the operation and characteristics of shunt-connected dc motors, series-connected dc motors, and universal motors, three-phase induction motors, three-phase synchronous machines, various types of single-phase ac motors, stepper motors, and brushless dc motors.	

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4094	***Bobot sks:*** 9	***Semester:*** 7/8	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Pilihan
Nama Matakuliah	Magang di Industri			
	Internships			
Silabus Ringkas	Untuk kesiapan mahasiswa terhadap kebutuhan dunia nyata, mahasiswa dapat terlibat langsung di industri terkait rekayasa selama masa satu semester. Selama kegiatan ini, mahasiswa dapat juga melakasankan kerja praktek (EL4092) dan EL4090 Tugas Akhir I (Capstone Design) sebagai bagian dari penugasannya di industri sebagai tenaga magang. Setiap mahasiswa harus memiliki seorang pembimbing di tempat magangnya			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	Untuk kesiapan mahasiswa terhadap kebutuhan dunia nyata, mahasiswa dapat terlibat langsung di industri terkait rekayasa selama masa satu semester. Selama kegiatan ini, mahasiswa dapat juga melakasankan kerja praktek (EL4092) dan EL4090 Tugas Akhir I (Capstone Design) sebagai bagian dari penugasannya di industri sebagai tenaga magang. Setiap mahasiswa harus memiliki seorang pembimbing di tempat magangnya			
Luaran (Outcomes)	Mahasiswa mengapresiasi keragaman masalah dan kendala di bidang rekayasa nyata Mahasiswa belajar beradaptasi dengan keragaman budaya dan organisasi di industri nyata Mahasiswa belajar beradaptasi dalam atmosfir multidisiplin dengan target terjadwal			
Matakuliah Terkait	Sudah lulus minimal 104 sks	Prasyarat		
	EL4090 Tugas Akhir I (Capstone Design)	Bersamaan		
	EL4092 Kerja Praktek	Bersamaan		
	Lihat Catatan tambahan	Prasyarat		
Kegiatan Penunjang	Kerja di Industri, Penugasan di Industri			
Pustaka	Rujukan Pilihan dari Industri Tempat Magang			
	Rujukan Buku pilihan Pembimbing di Industri			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Written report 60% Logbook 20% Seminar 20%			
Catatan Tambahan	Agar masa studi mahasiswa tidak lebih dari 9 semester, peserta harus sudah lulus semua matakuliah Semester-1 s/d Semester 6, yaitu minimal 104 sks			

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Kegiatan Magang 1	Sub Topik 1.1	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	Materi Industri 1
2	Kegiatan Magang 1	Sub Topik 1.2		Materi Industri 1
3	Kegiatan Magang 1	Sub Topik 1.3		Materi Industri 1
4	Kegiatan Magang 1	Sub Topik 1.4		Materi Industri 1
5	Kegiatan Magang 1	Sub Topik 1.5		Materi Industri 1
6	Kegiatan Magang 2	Sub Topik 2.1		Materi Industri 2
7	Kegiatan Magang 2	Sub Topik 2.2		Materi Industri 2
8	Kegiatan Magang 2	Sub Topik 2.3		Materi Industri 2
9	Kegiatan Magang 2	Sub Topik 2.4		Materi Industri 2
10	Kegiatan Magang 2	Sub Topik 2.5		Materi Industri 2
11	Kegiatan Magang 3	Sub Topik 3.1		Materi Industri 3
12	Kegiatan Magang 3	Sub Topik 3.2		Materi Industri 3
13	Kegiatan Magang 3	Sub Topik 3.3		Materi Industri 3
14	Kegiatan Magang 3	Sub Topik 3.4		Materi Industri 3
15	Kegiatan Magang 3	Sub Topik 3.5		Materi Industri 3

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL3213	***Bobot sks:*** 1	***Semester:*** 6	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Layanan/Pilihan
Nama Matakuliah	Praktikum Sistem Instrumentasi			
	Instrumentation Systems Lab			
Silabus Ringkas	Karakterisasi dan pengggunaan beberapa sensor dan transduser optik, sensor dan transduser thermal, sensor dan transduser mekanik, sensor dan transduser akustik			
Silabus Lengkap	Karakteristik sensor dan transduser optik, sensor dan transduser thermal, sensor dan transduser mekanik, sensor dan transduser akustik. Pengukuran intensitas cahaya dan pengaruh sudut datang dan panjang gelombang dengan LDR, Photocell, Photodiode, photo transistor. Pengukuran temperatur menggunakan PTC, NTC, bimetal dan IC. Pengukuran jarak menggunakan resistansi variabel, kapasitansi variabel, dan LVDT. Pengukuran jarak menggunakan sensor ultrasonik dan pengaruh daya pencar dan frekuensi terhadap pengukuran jarak.			
	[*Uraian lengkap silabus matakuliah dalam Bahasa Inggris (maksimum 100 kata)*]			
Luaran (Outcomes)				
Matakuliah Terkait	EL3013 Sistem Instrumentasi		Prasyarat	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Lab Manuals			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Lab reports 100%			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Transduser Optik	• Karakterisasi LDR, photocell, photodiode, phototransistor • Pengukuran intensitas cahaya • Pengaruh sudut datang • Pengaruh panjang gelombang	• Menjelaskan cara kerja tiap jenis sensor optik yang tersedia • Mengetahui pengaruh sudut datang terhadap hasil pengukuran • Mengetahui pengaruh frekuensi gelombang cahaya terhadap hasil pengukuran	Lab Manual 1
2	Transduser Termal	• Karakterisasi PTC • Karakterisasi NTC • Karakterisasi bimetal • Karakterisasi IC Temp sensor	• Menjelaskan cara kerja sensor termal • Mengidentifikasi kelebihan dan kekurangan sensor termal tsb • Mengetahui contoh aplikasi sensor termal	Lab Manual 2
3	Transduser Mekanik	• Karakterisasi resistor variabel • Karakterisasi kapsitor variabel • Karakterisasi induktor variabel • Karakterisasi LVDT	• Menjelaskan cara kerja tiap jenis sensor mekanik yd tersedia • Mengidentifikasi kelebihan dan kekurangan sensor mekanik tsb • Mengetahui contoh aplikasi sensor mekanik tsb	Lab Manual 3
4	Transduser Akustik	• Karakterisasi daerah frekuensi sensor ultrasonik • Pengaruh perubahan jarak terhadap hasil pengukuran	• Menjelaskan cara kerja sensor ultrasonik • Mengidentifikasi daerah kerja frekuensi sensor ultrasonik • Mengetahui pengaruh perubahan jarak terhadap hasil pengukuran	Lab Manual 4
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KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Mata kuliah: **EL2244**	Bobot SKS: **3**	Semester: **4**	KK / Unit Penanggungjawab: **Prodi S1 Teknik Elektro**	Sifat: **Wajib Prodi STI (Layanan dari Prodi Teknik Elektro)**
Nama Matakuliah	**Sistem dan Arsitektur Komputer**			
	Computer System & Architecture			
Silabus Ringkas	Kuliah ini membahas tentang sistem computer, mencakup perangkat keras, perangkat lunak, data dan prosedur, komunikasi dan manfaat bagi masyarakat penggunanya, sistem komputer *enterprise*			
	Student will gain a comprehensive knowledge about computer systems, its hardware components, software, data and procedures, communications, also the societies, *enterprise computer system, cloud computing*			
Silabus Lengkap	Membahas sistem computer digital modern dan timbal balik yang muncul ketika perangkat keras dan perangkat lunak saling berinteraksi. Topik meliputi: abstraksi computer, organisasi perangkat keras, instruction set architecture, representasi dan operasi data, sistem operasi, sistem pengolah (CPU), sistem memori, sistem input-output, analisis kinerja, serta pengantar arsitektur masa depan, sistem komputer *enterprise*			
	This course will give an in-depth understanding of the inner-workings of modern digital computer systems and tradeoffs present at the hardware-software interface. Topics include: computer abstraction, hardware organization, instruction set architecture, data representation and operation, software/operating system, CPU, systems, memory systems, input-output systems, performance analysis, and introduction of advance architecture *enterprise computer system, cloud computing* .			
Luaran (Outcomes)	1. Identify the abstraction of computer system 2. Identify some contributors to computer architecture and organization and relate their achievements to the knowledge area 3. Understanding that information is bits in context 4. Understanding how compilation systems work 5. Articulate differences between computer organization and computer architecture. 6. Identify some of the components of a computer. 7. Identify structure and function of computer 8. Understanding that the operating system manages the hardware 9. Describe how IT engineer uses or benefits from computer architecture and system 10. Understand *enterprise computer system,* 11. Understand *cloud computing system*			
Matakuliah Terkait	IF1210 Dasar Pemrograman	Prasyarat		
	EL2142 Sistem Digital & Mikroprosesor	Prasyarat		
Kegiatan Penunjang	Praktikum			
Pustaka	1. Randal E. Bryant and David R. Hallaron, Computer System A Programmer's Perspective, 2nd Edition, Prentice Hall, 2010 [CSAPP]			
	2. John L. Hennesy and David A. Patterson, Computer Organization and Design: The Software Hardware Interface, 4th Edition, Morgan Kaufmann Publisher, 2009 [COaD]			
	3. William Stallings, Computer Organization and Architecture: Designing for Perfornance, 8th Edition, Prentice Hall, 2010 [COaA]			
Panduan Penilaian	[Termasuk jenis dan bentuk penilaian]			

Catatan Tambahan	Update: 3 Maret 2013, Dr. Kusprasapta; Update: 8 April 2013, Dr. Arry Akhmad Arman; Update: 6 Sept 2013 Arief S-Rohman

Satuan Acara Perkuliahan

Mg#	Topik	Sub Topik	Capaian Belajar Mahasiswa	Sumber Materi
1	Introduction	Computer Abstraction Data and Information Compilation System Hardware Organization Architecture and Organization Structure and Function Operating System Personal and Career	Understanding the abstraction of computer system Understanding that information is bits in context Understanding how compilation systems work Articulate differences between computer organization and computer architecture. Identify some of the components of a computer. Identify structure and function of computer Understanding that the operating system manages the hardware Describe how IT engineer uses or benefits from computer architecture and system	CSAPP Ch 1, COaA Ch 1
2	Computer Evolution and Performance	History of computers Performance Analysis	Identify some contributors to computer architecture and organization and relate their achievements to the knowledge area. Understand the factors that contribute to computer performance. Understand the limitations of performance metrics. Select the most appropriate performance metric when evaluating a computer.	COaD Ch 1, COaA Ch 2
3	Computer Components and Interconnection	Top level view of computer Von Neumann machine Instruction cycle Datapath and Control	Explain the organization of a von Neumann machine and its machine and its major functional units. Explain how a computer fetches from memory and executes an instruction. Articulate the strengths and weakness of the von Neumann architecture.	COaD Ch 4, COaA Ch 3
4	Data Representation, Integer Representation and Operations, Floating Point	Binary representation and operation Big endian and little endian machine Unsigned and Signed Numbers. Range, Arithmetic Operations IEEE754, Representation, Range, Precision, Rounding, and Arithmetic operations	Appreciate how numerical values are represented in digital computers. Understand the limitations of computer arithmetic and the effects of errors on calculations. Appreciate how numerical values are represented in digital computers. Understand the limitations of computer arithmetic and the effects of errors on calculations.	CSAPP Ch 2 CSAPP Ch2 CSAPP Ch2
5	Processor Intel's Instruction Set Architecture	Data Formats, Accesing Information, ALU Ops, Control	Explain the relationship between the representation of machine level operation at the binary level and their representation by a symbolic assembler.	CSAPP Ch3

Mg#	Topik	Sub Topik	Capaian Belajar Mahasiswa	Sumber Materi
			Write small programs and fragments of assembly language code to demonstrate an understanding of machine level operations. Implement some fundamental high-level programming constructs at the machine-language level.	
6	Processor Intel's Instruction Set Architecture	Control and Procedure	Explain the relationship between the representation of machine level operation at the binary level and their representation by a symbolic assembler. Write small programs and fragments of assembly language code to demonstrate an understanding of machine level operations. Implement some fundamental high-level programming constructs at the machine-language level.	CSAPP Ch3
7	Processor Intel's Instruction Set Architecture	Array allocations, Structures, and unions	Explain the relationship between the representation of machine level operation at the binary level and their representation by a symbolic assembler. Write small programs and fragments of assembly language code to demonstrate an understanding of machine level operations. Implement some fundamental high-level programming constructs at the machine-language level.	CSAPP Ch3
8	Midterm			
9	Memory Hierarchy	Memory Technology, Cache, Virtual memory	Identify the main types of memory technology. Explain the effect of memory latency and bandwith on performance. Explain the use of memory hierarchy to reduce the effective memory latency. Describe the principles of memory management. Explain the use of memory hierarchy to reduce the effective memory latency. Describe the principles of memory management. Design an interface to memory.	COaD Ch5, CSAPP Ch6 COaD Ch6, CSAPP Ch10
10	I/O Subsystem	Peripherals and Storage	Explain how to use interrupts to implement I/O control and data transfers. Write small interrupt service routines and I/O drivers using assembly language. Identify various types of buses in a computer system. Describe data access from a magnetic disk drive. Analyze and implement interfaces. Compute the various parameters of performance for standard I/O	COaD Ch6

Mg#	Topik	Sub Topik	Capaian Belajar Mahasiswa	Sumber Materi
			types. Explain the basic nature human computer interaction devices. Describe data access from magnetic and optical disk drives. Understand how to interface and use peripheral chips. Write sufficient EPROM-based system software to create a basic stand-alone system Specify and design simple computer interfaces.	
11	Operating System		Understanding that the operating system manages the hardware	COaD Ch
12	Introduction to Superscalar, Parallel and Distributed System		Discuss how various architectural enhancements affect system performance Explain the differences between different paradigms and their usefulness and applicability. Discuss how to apply parallel processing approaches to design scalar and superscalar processors Understand how client server model works in a decentralized fashion. Understand how agents work and how they solve simple tasks.	COaD Ch7
13	Enterprises Computer System and Architecture	Data Center, Disaster Recovery Center, Large Scale Storage System, Data Replication DC-DRC	Understand the concept of DC-DRC Understand the storage technology Understand the impotance of storage system in modern Enterprise Computer System Know the tipical configuration of Enterprise Computer System	Berbabagai sumber
14		Data Center Design and Standard. SOA.	Know SOA Know Data Center Standard Know how to design Data Center	Berbabagai sumber
15	Cloud Computing System	Cloud Computing Services, Architecture, Performance. Case Study: Global Cloud Computing provider.	Understand the Concept of Cloud Computing Understand CC Services Understand the performances issues of CC	Berbabagai sumber

Silabus dan Contoh Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL2142	***Bobot sks:*** 4	***Semester:*** 2	***Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Layanan
Nama Matakuliah	Sistem Digital dan Mikroprosesor			
	Digital System dan Microprocessor			
Silabus Ringkas	[*Uraian ringkas silabus matakuliah dalam Bahasa Indonesia (maksimum 30 kata)*]			
	Fundamentals of digital logic and microprocessor system. Covers combinational and sequential logic circuits, programmable logic devices. Microprocessor system covers hardware, software, peripheral, interfacing and communication			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	The following topics will be covered: 12. Digital systems: digital computers and digital systems; binary, octal and hexadecimal number systems; complements; signed binary numbers; decimal and binary codes; introduction to binary logic 13. Boolean algebra: basic definitions, theorems and properties of Boolean algebra; Boolean functions;standard forms of Boolean functions; logic operations 14. Simplification of Boolean functions: Karnaugh map method; don't care condition; NAND and NOR 15. Combinational circuits: analysis and design procedures; adders, subtractors, multilevel NAND/NOR circuits and code conversion; transistor switches and practical design considerations 16. MSI and PLD devices: magnitude comparators, decoders, encoders, multiplexers, read-only memory (ROM), Programmable Logic Array (PLA), and Programmable Array Logic (PAL) 17. Analysis of synchronous sequential circuits: flip-flops; analysis of clocked sequential circuits; statereduction and assignment 18. Design of sequential circuits: flip-flop excita tion tables, design procedures, counter designs 19. Registers, counters and memory devices: shift registers, ripple counters, synchronous counters, timing sequences, and Random Access Memory (RAM) 20. Microprocessor system architecture: von Neumann, and Harvard machine. 21. Microprocessor system hardware: bus, bus timing, stack, interrupt, address decoder, peripheral and interfacing, serial communication 22. Microprocessor system software: flow chart, super loop and foreground background architecture, software to use timer, ADC, PWM, serial communicaton, Digital I/O (LED, 7 segment, LED matrix, switch, keypad), Analog I/O (sensors) 23. Microprocessor design methodology			
Luaran (Outcomes)	7. Be able to represent and manipulate numbers in the binary two's complement number system, and convert numbers between different positional number systems. Be able to do negation and addition in the two's complement number system, and detect overflow. 8. Carry out transformations of Boolean algebra expressions, using the theorems of Boolean algebra and Karnaugh maps. The student can find the minimal sum-of-products (SOP) and product-of-sums (POS) expressions, and create a corresponding circuit from AND, OR, NAND, and NOR gates. 9. The student will be able to analyze the functional and electrical behavior of digital CMOS circuits, including noise margins, allowable fan-in/out, and power dissipation. Given an NMOS or CMOS circuit diagram, the student can determine its logic function, using switch models for the transistors. The student can map simple functions onto programmable logic devices manually. 10. The student can analyze and design digital systems of moderate complexity using contemporary technology methods, including programmable logic devices and CAD tools. The student can use standard combinational and sequential digital building blocks including adders, multiplexers, decoders, encoders, and registers. 11. The student can analyze and design microprocessor system, the student realize how to use stack, interrupt, address decoder, peripheral, interface and serial communication. 12. The student can design and implement software for microprocessor, using super loop and foreground and background architecture 13. The student will be able to write proper lab reports, communicating their objectives, approach, observations, and conclusions			
Matakuliah Terkait	Pengantar Analisis Rangkaian	Prasyarat		
Kegiatan Penunjang	Praktikum			
Pustaka	S. Brown and Z. Vranesic: Fundamentals of Digital Logic and VHDL Design, 3rd Edition McGraw-Hill, 2009			
	J.T. Ronald, S.W. Neal, G.L. Moss, Digital Systems Principles and Applications 10th edition, Pearson, 2007			
	D. Gadre, Programming and Customizing the AVR Microcontroller, Mc Graw Hill, 2001			
Panduan Penilaian	[*Termasuk jenis dan bentuk penilaian*]			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Introduction		5. Identify some contributors to digital logic and microprocessor system, and relate their achievements to the knowledge area. 6. Explain why Boolen logic is important to this subject. 7. Articulate why gates are the fundamental elements of a digital system. 8. Describe how electrical engineering uses or benefits from digital logic and microprocessor system.	(S. Brown and Z. Vranesic) Chapter 1 (Ronald, Neal, Moss) Chapter 1
	Boolean Algebra + Logic Circuit		6. Derive and manipulate switching functions that form the basis of digital circuits. 7. Apply digital system design principles and techniques. 8. Model and simulate a digital system using schematic diagrams. 9. Model and simulate a digital system using a hardware description language, such as VHDL or Verilog. 10. Understand timing issues in digital systems and know how to study these via digital circuit simulation.	(S. Brown and Z. Vranesic) Chapter 2
2	Boolean Algebra + Logic Circuit		6. Derive and manipulate switching functions that form the basis of digital circuits. 7. Apply digital system design principles and techniques. 8. Model and simulate a digital system using schematic diagrams. 9. Model and simulate a digital system using a hardware description language, such as VHDL or Verilog. 10. Understand timing issues in digital systems and know how to study these via digital circuit simulation.	(S. Brown and Z. Vranesic) Chapter 2
	Implementation Technology		4. Realize switching functions with networks of logic gates. 5. Explain and apply fundamental characteristics of relevant electronic technologies, such as propagation delay, fan-in, fan-out, and power dissipation and noise margin. 6. Utilize programmable devices such as FPGAs and PLDs to implement digital system designs.	(S. Brown and Z. Vranesic) Chapter 3
3	Implementation Technology		4. Realize switching functions with networks of logic gates. 5. Explain and apply fundamental characteristics of relevant electronic technologies, such as propagation delay, fan-in, fan-out, and power dissipation and noise margin.	(S. Brown and Z. Vranesic) Chapter 3

			6. Utilize programmable devices such as FPGAs and PLDs to implement digital system designs.	
	Optimized Implementation of Logic Functions - KMAP		3. Derive and manipulate switching functions that form the basis of digital circuits. 4. Reduce switching functions to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 4
4	Optimized Implementation of Logic Functions - KMAP		3. Derive and manipulate switching functions that form the basis of digital circuits. 4. Reduce switching functions to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 4
	Number Representation & Arithmetic Circuit		2. Work with binary number systems and arithmetic.	(S. Brown and Z. Vranesic) Chapter 5
5	Combinational Circuit Building Blocks		3. Analyze and explain uses of small- and medium-scale logic functions as building blocks. 4. Analyze and design combinational logic networks in a hierarchical, modular approach, using standard and custom logic functions.	(S. Brown and Z. Vranesic) Chapter 6
	Combinational Circuit Building Blocks		3. Analyze and explain uses of small- and medium-scale logic functions as building blocks. 4. Analyze and design combinational logic networks in a hierarchical, modular approach, using standard and custom logic functions.	(S. Brown and Z. Vranesic) Chapter 6
6	Sequential Circuit Elements		7. Contrast the difference between a memory element and a register. 8. Indicate some uses for sequential logic. 9. Design and describe the operation of basic memory elements. 10. Analyze circuits containing basic memory elements. 11. Apply the concepts of basic timing issues, including clocking, timing constrains, and propagation delays during the design process. 12. Analyze and design functional building blocks and timing concepts of digital systems.	(S. Brown and Z. Vranesic) Chapter 7
	Sequential Circuit Elements		10. Contrast the difference between a memory element and a register. 11. Indicate some uses for sequential logic. 12. Design and describe the operation of basic memory elements. 13. Analyze circuits containing basic memory elements. 14. Apply the concepts of basic timing issues, including clocking, timing constrains, and propagation delays during the design process. 15. Analyze and design functional building blocks and timing concepts of digital systems.	(S. Brown and Z. Vranesic) Chapter 7

7	Synchronous State Machine		1. Analyze the behaviour of synchronous machines. 2. Design synchronous sequential machines. 3. Reduce the number of states to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 8
	Synchronous State Machine		4. Analyze the behaviour of synchronous machines. 5. Design synchronous sequential machines. 6. Reduce the number of states to simplify circuits used to realize them.	(S. Brown and Z. Vranesic) Chapter 8
8	Midterm Exam (Digital System)			(S. Brown and Z. Vranesic) Chapter 1-8
	Microprocessor System Architecture		1. Describe microprocessor system 2. Describe bus and its timing concept 3. Realize von Neumann vs Harvard machine	(Ronald, Neal, Moss)
9	Stack and Interupt		1. Realize role of stack on interrupt 2. Analyze relation between interrupt and stack	(Ronald, Neal, Moss)
10	Address Decoder		1. Create memory map 2. Design address decoder using digital logic circuit 3. Count and describe memory timing access	(Ronald, Neal, Moss)
11	Software Architecture		1. Design and describe super loop architecture 2. Design and describe foreground background (interrupt) architecture 3. Design and analyze program flow chart	(Ronald, Neal, Moss)
12	Peripheral		4. Describe internal peripheral of microcontroller 5. Design and analyze software to use timer, ADC, PWM 6. Design and analyze software and hardware for ADC 7. Design PWM application	(Ronald, Neal, Moss)
13	Serial Communication		6. Describe serial communication 7. Design serial communication software	(Ronald, Neal, Moss)
14	Interfacing	Digital I/O	6. Design hardware and software to access LED, switch, 7 segment display, LED matrix, keypad matrix	(Ronald, Neal, Moss)
	Interfacing	Analog I/O	6. Design hardware and software to access analog device, e.g. temperature sensor and light sensor	(Ronald, Neal, Moss)
15	Microprocessor System Toolchain and Design		1. Design, implementation software, debugging and analyze 2. Simple microprocessor system design	(Ronald, Neal, Moss)
	Final Exam (Microprocessor System)			(Ronald, Neal, Moss)

KURIKULUM ITB 2013-2018 – PROGRAM SARJANA
Program Studi Teknik Elektro
Sekolah Teknik Elektro dan Informatika

Silabus dan Satuan Acara Pengajaran (SAP)

Kode Matakuliah: EL4019	***Bobot sks:*** 3	***Semester:*** 8	***KK / Unit Penanggung Jawab:*** Prodi S1 Teknik Elektro	***Sifat:*** Layanan/Pilihan
Nama Matakuliah	Sistem Penggerak Elektrik			
	Eelectrical Drive Systems			
Silabus Ringkas				
	Elements of electric drive systems, introduction to solid states devices, introduction to solid state switching circuits, joint speed-torque charactesristics of electric motors and mechanical load, speed-torque characteristics of dc and ac electric motors, speed control of dc motors, speed control of induction motors, braking of dc motors, braking of induction motors, dynamic of electric drive systems			
Silabus Lengkap	[*Uraian lengkap silabus matakuliah dalam Bahasa Indonesia (maksimum 100 kata)*]			
	Students learn the basics of electric drive systems that consists of solid-state switching circuits and ac or dc electric motors , joint speed-torque charactesristics of electric motors and mechanical load, speed-torque characteristics of dc and ac electric motors, speed control of dc motors, speed control of induction motors, braking of dc motors, braking of induction motors, dynamic of electric drive systems			
Luaran (Outcomes)	Medapat model elektrik dan memahami karakterisitik umur beberapa jenis motor DC, motor AC, dan motor sinkron Menghitung daya dan rugi daya serta efisiensi motor AC Memahami cara kerja konverter ac/dc, dc/dc, dan dc/ac Memahami cara pengendalian kecepatan motor DC dan motor AC Memahami titik kerja sistem penggerak elektrik Memahami karakteristik dinamik sistem penggerak elektrik			
Matakuliah Terkait	EL2005 Elektronika		Prasyarat	
Kegiatan Penunjang	[*Praktikum, kerja lapangan, dsb.*]			
Pustaka	Lab Manuals			
	M. El-Sharkawi, Fundamentals of Electric Drives, Brooks/Cole Publishing Co., 2000			
	[*Penulis, Judul, Edisi, Penerbit, Tahun terbit*] ([*Pustaka utama/alternatif/pendukung*])			
Panduan Penilaian	Lab preparation and conduct (42%), Lab Reports (42%), Lab Note Book (15%), Review Exams (11%)			
Catatan Tambahan				

Mg#	*Topik*	*Sub Topik*	*Capaian Belajar Mahasiswa*	*Sumber Materi*
1	Electrical drive systems components; BJT sbg switch	[*Uraikan sub-topik bahasan*]	[*Uraikan capaian spesifik topik dengan merujuk kepada capaian matakuliah*]	[*Uraikan rujukan terhadap pustaka (bab, sub-bab)*]
2	Solid state devices; karakteristik SCR, AC/DC conversion for resistif & inductive loads			
3	Free wheeling diode; DC/DC DC/AC converters;			
4	Bi-didirectional elect drive systems, 4-quadrant drives; DC motor			
5	DC motors & Induction motors (starting & max torques, equivl. Circuits)			
6	Quiz1 Converters; Synch. Motors (power flow, var speed control); Dcmotor control w/ thyristor			
7	Synchronous motors (solid state cntrl, 1-phase half and full wave drives); IM speed control (adding resistance, rotor injected voltage)			
8	Quiz2 DC Speed motor control; AC speed motor controls (voltage & V/f control)			
9	V/f IM motor control; current source invereter IM motor control; Dynamic & regenerative brakings			
10	UTS IM Speed control; DC motor braking			
11	counter current braking DC motors; Quiz Chapter 9			
12	Induction motor brakings			
13	Induction motor brakings			
14	Dynamic of Electric Drives (DC & AC motors)			
15	Quiz3; Review materi kuliah			