Department of Electronics & Communication Engineering

Curriculum of B. Tech (Electronics & Communication Engineering)

FIRST SEMESTER
(COMMON TO ALL BRANCHES)

Sl. No	Sub. Code	Subject		L-T-P	Credits
1	MA 101	Mathematics – I		3-1-0	4
2	PH 101	Physics - I		3-1-0	4
3	CY 101	Chemistry		3-1-0	4
4	EE 100 EC 100	Basic Electrical Technology Basic Electronics Engineering	OR	3-1-0	4
5	CE 110 CE 130	Engineering Mechanics Environmental and Safety Engineering	OR	3-1-0	4
6	PH 170 CY 170	Physics Laboratory Chemistry Laboratory	OR	0-0-3	2
7	CS 171	Computing Laboratory – I		0-0-3	2
8	CE 171	Engineering Drawing		0-0-3	2
9	WS 171	Workshop Practice – I		0-0-3	2
10		Extra Academic Activity – I		0-0-3	2
	TOTAL			15-5-15	**30**

SECOND SEMESTER
(COMMON TO ALL BRANCHES)

Sl. No	Sub. Code	Subject		L-T-P	Credits
1	MA 102	Mathematics - II		3-1-0	4
2	PH 102	Physics – II		3-1-0	4
3	CS 102	Data Structures and Algorithm		3-1-0	4
4	EC 100 EE 100	Basic Electronics Engineering Basic Electrical Technology	OR	3-1-0	4
5	CE 130 CE 100	Environmental and Safety Engineering Engineering Mechanics	OR	3-1-0	4
6	CY 170 PH 170	Chemistry Laboratory Physics Laboratory	OR	0-0-3	2
7	CS 172	Computing Laboratory – II		0-0-3	2
8	ME 170	Machine Drawing and Solid Modeling		0-0-3	2
9	WS 172	Workshop Practice – II		0-0-3	2
10		Extra Academic Activity – II		0-0-3	2
	TOTAL			15-5-15	**30**

THIRD SEMESTER

Sl. No	Sub. Code	Subject	L-T-P	Credit
1	MA 201	Mathematics - III	3-1-0	4
2	ME 250	Thermal Engineering	3-0-0	3
3	EC 201	Analog Electronics	3-1-0	4
4	EC 203	Networks (Signal and Network)	3-1-0	4
5		HS and Open Elective - I	3-0-0	3
6	MA 270	Numerical Methods Laboratory	0-0-3	2
7	ME 271	Thermal Engineering Laboratory	0-0-3	2
8	EC 270	Basic Electronics Laboratory.	0-0-3	2
9	EC 273	Circuit Simulation Lab	0-0-3	2
TOTAL				**26**

FOURTH SEMESTER

Sl. No	Sub. Code	Subject	L-T-P	Credit
1	MA 202	Mathematics – IV	3-1-0	4
2	EE 202	Electrical Engineering	3-1-0	4
3	EC 202	Digital Electronics	3-0-0	3
4		Professional Elective – I	3-0-0	3
5		HS and Open Elective – II (Management)	3-0-0	3
6	EE 270	Basic Electrical Engineering Laboratory	0-0-3	2
7	EC 274	Analog Electronics Laboratory	0-0-3	2
8	EC 276	Digital Electronics Laboratory	0-0-3	2
9	HS 270	Language Laboratory	0-0-3	2
TOTAL				**25**

FIFTH SEMESTER

Sl. No	Sub. Code	Subject	L-T-P	Credit
1	EC 301	Microprocessors	3-0-0	3
2	EC 311	Analog Communication Systems	3-1-0	4
3	EC 331	Control System Engineering	3-1-0	4
4	EC 341	Digital Signal Processing	3-0-0	3
5		HS & Open Elective – III	3-0-0	3
6	EC 371	Microprocessors Laboratory	0-0-3	2
7	EC 373	Analog Communication Laboratory	0-0-3	2
8	EC 375	DSP Laboratory	0-0-3	2
9		Elective Lab-I	0-0-3	2
TOTAL				*25*

SIXTH SEMESTER

Sl. No	Sub. Code	Subject	L-T-P	Credit
1	EC 312	Electromagnetic Theory	3-0-0	3
2	EC 314	Digital Communication	3-0-0	3
3		Professional Elective – II	3-1-0	4
4		Professional Elective – III	3-0-0	3
5		HS and Open Elective – IV	3-1-0	4
6	EC 372	Digital Communication Laboratory	0-0-3	2
7		Elective Lab – II	0-0-3	2
8		Elective Lab – III	0-0-3	2
9	EC 382	Communication System Design Lab	0-0-3	2
TOTAL				**25**

SEVENTH SEMESTER

Sl. No	Sub. Code	Subject	L-T-P	Credit
1		Professional Elective – IV	3-0-0	4
2		Professional Elective – V	3-0-0	4
3		Professional Elective – VI	3-0-0	4
4		HS and Open Elective – V	3-0-0	3
5		Elective Lab – IV	0-0-3	2
6	EC 491	Research Project – I	0-0-6	4
7	EC 493	Seminar and Technical Writing – I	0-0-3	2
8	EC 495	Short term Industrial / Research Experience	0-0-0	2
TOTAL				**25**

EIGHTH SEMESTER

Sl. No	Sub. Code	Subject	L-T-P	Credit
1		Professional Elective – VIII	3-1-0	4
2		Professional Elective – IX	3-0-0	4
3		Professional Elective – X	3-0-0	4
4		HS and Open Elective – VI	3-0-0	3
5		Elective Lab – V	0-0-3	2
6	EC 492	Research Project – II	0-0-9	6
7	EC 494	Seminar and Technical Writing – I	0-0-3	2
8	EC 496	Comprehensive Viva Voce	0-0-0	2
TOTAL				**27**

LIST OF PROFESSIONAL ELECTIVES

Sl.No.	Sub Code	Subject	L-T-P	Credits
1.	CS 242	Computer Organization and Architecture	3-1-0	4
2.	CS 326	Data Communication and Computer Graphics	3-0-0	3
3.	CS 442	Computer System Architecture	3-0-0	3
4.	EC 204	Semiconductor Devices	3-0-0	3
5.	EC 232	Electrical and Electronic Measurement	3-0-0	3
6.	EC 314	Digital Communication	3-0-0	3
7.	EC 316	Microwave Engineering	3-0-0	3
8.	EC 322	Embedded Systems	3-0-0	3
9.	EC 391	Special Topic in Electronics & Comm Engg – I		03/04
10.	EC 392	Special Topic in Electronics & Comm Engg – II		03/04
11.	EC 393	Special Laboratory in Electronics & Comm Engg – I	0-0-3	2
12.	EC 394	Special Laboratory in Electronics & Comm Engg - II	0-0-3	2
13.	EC 395	Engineering Product Development Project – I	0-0-6	4
14.	EC 396	Engineering Product Development Project – II	0-0-6	4
15.	EC 410	Antenna Engineering	3-0-0	3
16.	EC 411	Coding Theory and Secure Communication	3-0-0	3
17.	EC 412	Antenna Analysis and Synthesis	3-1-0	4
18.	EC 413	Optical Communication	3-1-0	4
19.	EC 414	Information Theory and Coding	3-1-0	4
20.	EC 415	Mobile Communication	3-1-0	4
21.	EC 417	Satellite Communication	3-1-0	4
22.	EC 419	Computer Communication Network	3-1-0	4
23.	EC 421	Digital VLSI Design	3-1-0	4
24.	EC 423	HDL and High Level VLSI	3-1-0	4
25.	EC 424	Embedded Computing System	3-1-0	4
26.	EC 442	Advanced Techniques in Digital Signal Processing	3-1-0	4
27.	EC 443	Digital Image Processing	3-0-0	3
28.	EC 444	Soft Computing	3-1-0	4
29.	EC 446	Adaptive Signal Processing	3-1-0	4
30.	EC 448	Evolutionary Computing Techniques	3-1-0	4
31.	EE 335	Advanced Instrumentation	3-0-0	3
32.	EE 355	Computer Organization and Operating Systems	3-0-0	3
33.	EE 426	Fuzzy Modeling and Control	3-0-0	3
34.	EE 427	Artificial Neural Network	3-0-0	3
35.	EE 454	Data Communication and Networking	3-0-0	3

LIST OF ELECTIVE LAB COURSES

1.	EC 377	Electronics Design Lab	0-0-3	2
2.	EE 377	Control System Lab	0-0-3	2
3.	EC 374	Instrumentation Device Lab	0-0-3	2
4.	EC 477	Mobile Communication Lab	0-0-3	2
5.	EC 472	Image Processing Lab	0-0-3	2
6.	EC 378	Mirowave Lab	0-0-3	2
7.	EC 473	High Level VLSI Lab	0-0-3	2
8.	EC 474	DSP Processor Lab	0-0-3	2
9.	EC 475	VLSI Lab	0-0-3	2
10.	EC 478	Antenna Design Lab	0-0-3	2
11.	EC 370	Embedded Systems Lab	0-0-3	2
12.	EC 471	Optical communication Lab	0-0-3	2
13.	EC 379	PCB Design Lab	0-0-3	2
14.	CS 471	Networks Lab	0-0-3	2

Department of Electronics & Communication Engineering

Curriculum of B. Tech (Electronics & Instrumentation Engineering)

FIRST SEMESTER
(COMMON TO ALL COURSES)

Sl.No	Sub. Code	Subject		L-T-P	Credits
1	MA 101	Mathematics – I		3-1-0	4
2	PH 101	Physics – I		3-1-0	4
3	CY 101	Chemistry		3-1-0	4
4	EE 100 EC 100	Basic Electrical Technology Basic Electronics Engineering	OR	3-1-0	4
5	CE 110 CE 130	Engineering Mechanics Environmental and Safety Engineering	OR	3-1-0	4
6	PH 170 CY 170	Physics Laboratory Chemistry Laboratory	OR	0-0-3	2
7	CS 171	Computing Laboratory – I		0-0-3	2
8	CE 171	Engineering Drawing		0-0-3	2
9	WS 171	Workshop Practice – I		0-0-3	2
10		Extra Academic Activity – I		0-0-3	2
TOTAL				15-5-15	**30**

SECOND SEMESTER
(COMMON TO ALL COURSES)

Sl.No	Sub. Code	Subject		L-T-P	Credits
1	MA 102	Mathematics – II		3-1-0	4
2	PH 102	Physics – II		3-1-0	4
3	CS 102	Data Structures and Algorithm		3-1-0	4
4	EC 100 EE 100	Basic Electronics Engineering Basic Electrical Technology	OR	3-1-0	4
5	CE 130 CE 110	Environmental and Safety Engineering Engineering Mechanics	OR	3-1-0	4
6	CY 170 PH 170	Chemistry Laboratory Physics Laboratory	OR	0-0-3	2
7	CS 172	Computing Laboratory – II		0-0-3	2
8	ME 170	Machine Drawing and Solid Modeling		0-0-3	2
9	WS 172	Workshop Practice – II		0-0-3	2
10		Extra Academic Activity – II		0-0-3	2
TOTAL				15-5-15	**30**

THIRD SEMESTER

Sl.No	Sub. Code	Subject	L-T-P	Credits
1	MA 201	Mathematics – III	3-1-0	4
2	ME 253	Thermal Engineering	3-1-0	4
3	EC 201	Analog Electronics	3-1-0	4
4	EC 203	Networks	3-1-0	4
5		HS & Open Elective – I	3-0-0	3
6	MA 270	Numerical Methods Laboratory	0-0-3	2
7	ME 271	Thermal Engineering Laboratory	0-0-3	2
8	EC 270	Basic Electronics Laboratory	0-0-3	2
9	EC 273	Circuit Simulation Lab	0-0-3	2
TOTAL				*27*

FOURTH SEMESTER

Sl.No	Sub. Code	Subject	L-T-P	Credits
1	MA 202	Mathematics – IV	3-1-0	4
2	EE 202	Electrical Engineering	3-1-0	4
3	EC 202	Digital Electronics	3-0-0	3
4		Professional Elective – I	3-0-0	3
5		HS & Open Elective – II (Management)	3-0-0	3
6	EE 270	Basic Electrical Engineering Laboratory	0-0-3	2
7	EC 274	Analog Electronics Laboratory	0-0-3	2
8	EC 276	Digital Electronics Laboratory	0-0-3	2
9	HS 270	Language Laboratory	0-0-3	2
TOTAL				*25*

FIFTH SEMESTER

Sl.No	Sub. Code	Subject	L-T-P	Credits
1	EC 301	Microprocessors	3-0-0	3
2	EC 311	Analog Communication Systems	3-1-0	4
3	EC 331	Control System Engineering	3-1-0	4
4	EC 341	Digital Signal Processing	3-0-0	3
5		HS & Open Elective – III	3-0-0	3
6	EC 371	Microprocessors Laboratory	0-0-3	2
7	EC 373	Analog Communication Laboratory	0-0-3	2
8	EC 375	DSP Laboratory	0-0-3	2
9	EC 377	Elective Lab-I	0-0-3	2
TOTAL				*25*

SIXTH SEMESTER

Sl.No	Sub. Code	Subject	L-T-P	Credits
1	EC 332	Electronic Instrumentation	3-1-0	4
2	EC 334	Instrumentation Devices	3-1-0	4
3		Professional Elective – II	3-1-0	4
4		Professional Elective – III	3-0-0	3
5		HS & Open Elective-IV (Information Technology)	3-1-0	4
6	EC 374	Instrumentation Device Lab	0-0-3	2
7	EC 380	Control System Lab	0-0-3	2
8		Elective Lab – II	0-0-3	2
9		Elective Lab – III	0-0-3	2
TOTAL				*25*

SEVENTH SEMESTER

Sl.No	Sub. Code	Subject	LTP	Credits
1		Professional Elective – IV	3-1-0	4
2		Professional Elective – V	3-1-0	4
3		Professional Elective – VI	3-1-0	4
4		HS & Open Elective – V	3-0-0	3
5		Elective Lab – IV	0-0-3	2
6	EC 491	Research Project – I	0-0-6	4
7	EC 493	Seminar and Technical Writing – I	0-0-3	2
8	EC 495	Short term Industrial / Research Experience	0-0-0	2
TOTAL				*25*

EIGHTH SEMESTER

Sl.No	Sub. Code	Subject	LTP	Credits
1		Professional Elective – VIII	3-1-0	4
2		Professional Elective – IX	3-0-0	4
3		Professional Elective – X	3-0-0	4
4		HS & Open Elective – IV	3-0-0	3
5		Elective Lab – V	0-0-3	2
6	EC 492	Research Project – II	0-0-9	6
7	EC 494	Seminar and Technical Writing - I	0-0-3	2
8	EC 496	Comprehensive Viva Voce	0-0-0	2
TOTAL				*27*

LIST OF PROFFESIONAL ELECTIVES

Sl.No	Sub. Code	Subject	LTP	Credits
1.	BM 311	Bio transducer & Biosensor	3-1-0	4
2.	BM 312	Biomedical Signal Processing	3-0-0	3
3.	CS 242	Computer Organization and architecture	3-1-0	4
4.	CS 326	Data Communication and Computer Graphics	3-0-0	3
5.	CS 442	Computer System Architecture	3-0-0	3
6.	EC 204	Semiconductor Devices	3-0-0	3
7.	EC 232	Electrical and Electronic Measurements	3-0-0	3
8.	EC 312	Electromagnetic Theory	3-0-0	3
9.	EC 314	Digital Communication	3-0-0	3
10.	EC 322	Embedded Systems	3-0-0	3
11.	EC 336	Industrial Instrumentation	3-1-0	4
12.	EC 338	Virtual Instrumentation	3-0-0	3
13.	EC 393	Special Laboratory in Electronics & Instrumentation Engg - I	0-0-3	2
14.	EC 394	Special Laboratory in Electronics & Instrumentation Engg - II	0-0-3	2
15.	EC 395	Engineering Product Development Project – I	0-0-6	4
16.	EC 396	Engineering Product Development Project – II	0-0-6	4
17.	EC 397	Special Topic in Electronics & Instrumentation – I		03/04
18.	EC 398	Special Topic in Electronics & Instrumentation – II		03/04
19.	EC 410	Antenna Engineering	3-0-0	3
20.	EC 413	Optical Communications	3-1-0	4
21.	EC 414	Information Theory and Coding	3-1-0	4
22.	EC 415	Mobile Communication	3-1-0	4
23.	EC 419	Computer Communication Networks	3-1-0	4
24.	EC 421	Digital VLSI Design	3-1-0	4
25.	EC 423	HDL and High Level VLSI	3-1-0	4
26.	EC 424	Embedded Computing Systems	3-1-0	4
27.	EC 431	PC based Instrumentation	3-0-0	3
28.	EC 432	Biomedical Instrumentation	3-0-0	3
29.	EC 433	Process Control Instrumentation	3-0-0	3
30.	EC 434	Analytical Instrumentation	3-0-0	3
31.	EC 437	Radar Engineering	3-0-0	3
32.	EC 442	Advanced Techniques in Digital Signal Processing	3-1-0	4
33.	EC 443	Digital Image Processing	3-0-0	3
34.	EC 446	Adaptive Signal Processing	3-1-0	4
35.	EC 448	Evolutionary Computing Techniques	3-1-0	4
36.	EE 335	Advanced Instrumentation	3-0-0	3
37.	EE 355	Computer Organization and Operating Systems	3-0-0	3
38.	EE 426	Fuzzy Modeling and Control	3-0-0	3
39.	EE 427	Artificial Neural Network	3-0-0	3
40.	EE 454	Data Communication and Networking	3-0-0	3

LIST OF ELECTIVE LAB COURSES

1	BM 371	Biomedical Equipment Laboratory	0-0-3	2
2	CS 471	Networks Lab	0-0-3	2
3	EC 370	Embedded Systems Lab	0-0-3	2
4	EC 377	Electronics Design Lab	0-0-3	2
5	EC 379	PCB Design Lab	0-0-3	2
6	EC 472	Image Processing Lab	0-0-3	2
7	EC 473	High Level VLSI Lab	0-0-3	2
8	EC 474	DSP Processor Lab	0-0-3	2
9	EC 475	VLSI Lab	0-0-3	2
10	EC 477	Mobile Communication Lab	0-0-3	2
11	EE 377	Control System Lab	0-0-3	2

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

SUMMARY OF COURSES

Sub Discipline: Circuit and Systems

EC 100	Basic Electronics	3-1-0	4
EC 201	Analog Electronics	3-1-0	4
EC 202	Digital Electronics	3-0-0	3
EC 203	Signal and Networks	3-1-0	4
EC 204	Semiconductor Devices	3-0-0	3
EC 301	Microprocessor	3-0-0	3

Sub Discipline: Communication

EC 311	Analog Communication Systems	3-1-0	4
EC 312	Electromagnetic Theory	3-0-0	3
EC 314	Digital Communication	3-0-0	3
EC 316	Microwave Engineering	3-0-0	3
EC 410	Antenna Engineering	3-0-0	3
EC 411	Coding Theory and Secure Communication	3-0-0	3
EC 412	Antenna Analysis and Synthesis	3-1-0	4
EC 413	Optical Communication	3-1-0	4
EC 417	Satellite Communication	3-1-0	4
EC 414	Information Theory and Coding	3-1-0	4
EC 415	Mobile Communication	3-1-0	4
EC 419	Computer Communication Networks	3-1-0	4

Sub Discipline: VLSI and Embedded Systems

EC 322	Embedded Systems	3-0-0	3
EC 421	Digital VLSI design	3-1-0	4
EC 423	HDL and High Level VLSI	3-1-0	4

Sub Discipline: Instrumentation Systems

EC 232	Electrical and Electronics Measurements	3-0-0	3
EC 331	Control System Engineering	3-1-0	4
EC 332	Electronics Instrumentation	3-0-0	3
EC 334	Instrumentation Devices	3-0-0	3
EC 336	Industrial Instrumentation	3-1-0	4
EC 338	Virtual Instrumentation	3-1-0	4
EC 431	PC Based Instrumentation	3-0-0	3
EC 432	Biomedical Instrumentation	3-0-0	3
EC 433	Process Control Instrumentation	3-0-0	3
EC 434	Analytical Instrumentation	3-0-0	3
EC 437	Radar Engineering	3-0-0	3

Sub Discipline: Signal Processing

EC 341	Digital Signal Processing	3-0-0	3
EC 443	Digital Image Processing	3-0-0	3
EC 442	Advanced Techniques in Digital Signal Processing	3-1-0	4
EC 444	Soft Computing	3-1-0	4
EC 446	Adaptive Signal Processing	3-1-0	4
EC 448	Evolutionary Computing and Application	3-1-0	4

Sub Discipline: Laboratory Courses

EC 270	Basic Electronics Laboratory.	0-0-3	2
EC 273	Circuit Simulation Lab		
EC 274	Analog Electronics Laboratory	0-0-3	2
EC 276	Digital Electronics Laboratory	0-0-3	2
EC 371	Microprocessors Laboratory	0-0-3	2
EC 372	Digital Communication Laboratory	0-0-3	2
EC 373	Analog Communication Laboratory	0-0-3	2
EC 374	Instrumentation Device Laboratory	0-0-3	2
EC 375	DSP Laboratory	0-0-3	2
EC 376	Virtual Instrumentation Lab	0-0-3	2
EC 377	Electronic Design Lab	0-0-3	2
EC 378	Microwave Lab	0-0-3	2
EC 379	PCB Design Lab	0-0-3	2
EC 380	Control System Lab	0-0-3	2
EC 382	Communication System Design Lab	0-0-3	2
EC 475	VLSI Lab	0-0-3	2
EC 476	Bio-Medical lab	0-0-3	2
EC 478	Antenna Design Lab	0-0-3	2
EC 479	Process Control Lab	0-0-3	2

Sub Disciplines: Project, Seminar and Special Courses

EC 391	Special Topic in Electronics & Instrumentation - I		3/4
EC 392	Special Topic in Electronics & Instrumentation - II		3/4
EC 393	Special Laboratory in Electronics & Instru Engg - I	0-0-3	2
EC 394	Special Laboratory in Electronics & Instru Engg - II	0-0-3	2
EC 395	Engineering Product Development Project - I	0-0-6	4
EC 396	Engineering Product Development Project - II	0-0-6	4
EC 397	Special Topic in Electronics & Instrumentation - I		3/4
EC 398	Special Topic in Electronics & Instrumentation - II		3/4
EC 491	Research Project - I	0-0-6	4
EC 492	Research Project - II	0-0-9	6
EC 493	Seminar and Technical Writing - I	0-0-3	2
EC 494	Seminar and Technical Writing - I	0-0-3	2
EC 495	Short term Industrial/Research Professional Experience	0-0-0	2
EC 496	Comprehensive Viva Voce	0-0-0	2

COURSES OFFERED AS OPEN ELECTIVES

Sl.No	Sub Code.	Subject	L-T-P	Credits
1.	EC 200	Fundamentals of Communication Systems	3-0-0	3
2.	EC 301	Microprocessor	3-0-0	3
3.	EC 341	Digital Signal Processing	3-0-0	3
4.	EC 433	Process Control and Instrumentation	3-0-0	3
5.	EC 432	Biomedical Instrumentation	3-0-0	3
6.	EC 443	Digital Image Processing	3-0-0	3
7.	EC 322	Embedded Systems	3-0-0	3
8.	EC 421	Digital VLSI Design	3-1-0	4
9.	EC 448	Evolutionary Computing Techniques	3-1-0	4

DETAILED SYLLABI OF COURSES

Sl. No.	Sub. Code	Subject	L-T-P	Credits
1.	EC 100	Basic Electronics	3-1-0	4
2.	EC 200	Fundamentals of Communication Systems	3-0-0	3
3.	EC 201	Analog Electronics	3-1-0	4
4.	EC 202	Digital Electronics	3-0-0	3
5.	EC 203	Signal and Networks	3-1-0	4
6.	EC 204	Semiconductor Devices	3-0-0	3
7.	EC 232	Electrical and Electronics Measurements	3-0-0	3
8.	EC 270	Basic Electronics Laboratory.	0-0-3	2
9.	EC 273	Circuit Simulation Lab	0-0-3	2
10.	EC 274	Analog Electronics Laboratory	0-0-3	2
11.	EC 276	Digital Electronics Laboratory	0-0-3	2
12.	EC 301	Microprocessor	3-0-0	3
13.	EC 311	Analog Communication Systems	3-1-0	4
14.	EC 312	Electromagnetic Theory	3-0-0	3
15.	EC 314	Digital Communication	3-0-0	3
16.	EC 316	Microwave Engineering	3-1-0	4
17.	EC 322	Embedded Systems	3-0-0	3
18.	EC 331	Control System Engineering	3-1-0	4
19.	EC 332	Electronics Instrumentation	3-1-0	4
20.	EC 334	Instrumentation Devices	3-1-0	4
21.	EC 336	Industrial Instrumentation	3-1-0	4
22.	EC 338	Virtual Instrumentation	3-1-0	4
23.	EC 341	Digital Signal Processing	3-0-0	3
24.	EC 370	Embedded Systems Lab	0-0-3	2
25.	EC 371	Microprocessors Laboratory	0-0-3	2
26.	EC 372	Digital Communication Laboratory	0-0-3	2
27.	EC 373	Analog Communication Laboratory	0-0-3	2
28.	EC 374	Instrumentation Device Laboratory	0-0-3	2
29.	EC 375	DSP Laboratory	0-0-3	2
30.	EC 376	Virtual instruments Lab	0-0-3	2
31.	EC 377	Electronic Design Lab	0-0-3	2
32.	EC 378	Microwave Lab	0-0-3	2
33.	EC 379	PCB Design Lab	0-0-3	2
34.	EC 380	Control System Lab	0-0-3	2
35.	EC 382	Communication System Design Lab	0-0-3	2
36.	EC 391	Special Topic in Electronics & Instrumentation - I		3/4
37.	EC 392	Special Topic in Electronics & Instrumentation - II		3/4
38.	EC 393	Special Laboratory in Electronics & Instru Engg - I	0-0-3	2
39.	EC 394	Special Laboratory in Electronics & Instru Engg - II	0-0-3	2
40.	EC 395	Engineering Product Development Project - I	0-0-6	4
41.	EC 396	Engineering Product Development Project - II	0-0-6	4
42.	EC 410	Antenna Engineering	3-0-0	3
43.	EC 411	Coding Theory and Secure Communication	3-0-0	3
44.	EC 412	Antenna Analysis & Synthesis	3-1-0	4

45.	EC 412	Antenna Analysis and Synthesis	3-1-0	4
46.	EC 413	Optical Communication	3-1-0	4
47.	EC 414	Information Theory and Coding	3-1-0	4
48.	EC 415	Mobile Communication	3-1-0	4
49.	EC 417	Satellite Communication	3-1-0	4
50.	EC 419	Computer Communication Network	3-1-0	4
51.	EC 421	Digital VLSI Design	3-1-0	4
52.	EC 423	HDL and High Level VLSI	3-1-0	4
53.	EC 424	Embedded Computing Systems	3-1-0	4
54.	EC 431	PC Based Instrumentation	3-0-0	3
55.	EC 432	Biomedical Instrumentation	3-0-0	3
56.	EC 433	Process Control and Instrumentation	3-0-0	3
57.	EC 434	Analytical Instrumentation	3-0-0	3
58.	EC 437	Radar Engineering	3-0-0	3
59.	EC 442	Advanced Techniques in Digital Signal Processing	3-1-0	4
60.	EC 443	Digital Image Processing	3-0-0	3
61.	EC 444	Soft Computing	3-1-0	4
62.	EC 446	Adaptive Signal Processing	3-1-0	4
63.	EC 448	Evolutionary Computing Techniques	3-1-0	4
64.	EC 471	Optical Communication Lab	0-0-3	2
65.	EC 472	Image Processing Lab	0-0-3	2
66.	EC 473	VHDL Lab	0-0-3	2
67.	EC 474	DSP Processor Lab	0-0-3	2
68.	EC 475	VLSI Lab	0-0-3	2
69.	EC 476	Bio-Medical lab	0-0-3	2
70.	EC 477	Mobile Communication Lab	0-0-3	2
71.	EC 478	Antenna Design Lab	0-0-3	2
72.	EC 479	Process Control Lab	0-0-3	2
73.	EC 491	Research Project – I	0-0-6	4
74.	EC 492	Research Project – II	0-0-9	6
75.	EC 493	Seminar and Technical Writing - I	0-0-3	2
76.	EC 494	Seminar and Technical Writing	0-0-3	2
77.	EC 495	Short term Industrial/Research Professional Experience	0-0-0	2
78.	EC 496	Comprehensive Viva Voce	0-0-0	2

EC 100 BASIC ELECTRONICS 4 credits [3-1-0]

Introduction to electronics: Signals, frequency spectrum of signals, analog and digital signals, amplifiers, frequency response of amplifiers, digital logic inverters. Linear wave-shaping circuits: RC Low pass filter, integrator; RC High pass filter, differentiator. Operational Amplifiers: Ideal OPAMP, Inverting, Adder, Integrator, Differentiation, Non-inverting applications, ADC and DAC. Diodes: The p-n junction theory, Analysis of Diode circuits, Small signal model, Different types of diodes. Bipolar Junction Transistors (BJTs): Physical structure and modes of operation, characteristics, DC Analysis, Introduction to Small Signal Analysis, Biasing Circuits. Field Effect Transistors: Structure and physical operation of Enhancement type MOSFET, Current voltage characteristic of enhancement MOSFET, depletion MOSFET, MOSFET circuits in DC, JFET and MSFET. Electronic Instruments: Ammeter, Voltmeter, Multimeter, Digital Multimeter, Cathode Ray Oscilloscopes. Fundamentals of Communication Systems: Principle of communication system, Fundamental of AM & FM, Radio & TV Transmitters and Receivers.

Essential Reading:

1. A.S. Sedra, K.C. Smith, *Microelectronic Circuits*, Oxford University Press, India, 2005
2. A Malvino, D J Bates; *Electronic Principles*, Tata McGraw Hill, India, (ISBN: 0-07-063424-6); 2007

Supplementary Reading:

1. R C Jaeger, T N Blalock, *Microelectronic Circuit Design*; Tata McGraw Hill, 2006 (ISBN: 0-07-060162-3).

EC 200 FUNDAMENTALS OF COMMUNICATION SYSTEMS 2 credits [3-0-0]

Introduction to communication systems, signals and spectrum, noise, types of modulation; AM, FM, PM and radio receivers. Fourier Transform Analysis, generation and demodulation of AM and FM signals including double-sideband suppressed carrier, SSB. Frequency Division Multiplexing (FDM).Digital Modulation Techniques, Sampling theorem, pulse code modulation, delta modulation, base band transmission, transmission errors, entropy, channel capacity, A brief introduction to Optical Communication and cellular communication.

Essential Reading:

1. George Kennedy, "*Electronic Communication Systems*," TATA McGraw-Hill Publishing House.
2. S. Haykin, *Communication Systems*, 4th ed., John Wiley & Sons, 2001

Supplementary Reading:

1. T. Schilling, "*Principles of Communication Systems*" TATA McGraw-Hill Publishing House.
2. B.P. Lathi, *"Modern Digital and Analog Communication Systems*," Oxford University Press
3. G. Keiser, "*Optical Fiber Communications*," TATA McGraw-Hill Publishing House.

EC 201 ANALOG ELECTRONICS 4 credits [3-1-0]

Prerequisites: EC 100: Basic Electronics

Bipolar Junction Transistor: Review of BJT operation and DC biasing, Small Signal model, BJT biasing for discrete circuit design, single stage amplifier analysis, complete static characteristic, internal capacitances and second order effect.; Field-Effect Transistor: Review of JFET, Depletion and Enhancement MOSFET operation, characteristic and DC biasing, MOSFET as amplifier, biasing of MOS amplifier circuits, single stage IC-MOS amplifiers, CMOS logic inverter, MOSFET as analog switch, Small signal model of MOSFET for high and low frequencies. ; Spice model and analysis of FET circuits.; Frequency Response Analysis: S-domain analysis, Bode plot, amplifier transfer function, low frequency and high frequency response of common-source and common drain amplifiers, frequency response analysis of other single stage transistor amplifier configuration.; Feedback Amplifier: General feed-back structures, negative feedback, the 4 basis feedback topologies and their analysis, close loop gain calculation, amplifier stability analysis using Bode plot.; Output stage and Power Amplifier: Classification of output stages, Class A, Class B, Class AB amplifiers, power BJT, IC power transistors and MOS power transistors.; Differential and Multistage Amplifier: BJT differential amplifier, Small signal operation of BJT differential amplifier, non-ideal characteristics of differential amplifier, biasing of BJT ICs, multistage amplifiers; Spice model and analysis of all circuits.

Essential Reading:

1. A.S. Sedra and K.C. Smith, *Microelectronic Circuits,* Oxford University Press; 2005.

Supplementary Reading:

1. Spencer and Ghausi, *Introduction to Electronic Circuit Design*, Pearson Education, 2003
2. A. Dutta, *Semiconductor Devices and Circuits*, Oxford University Press, ND 2008

EC 202 DIGITAL ELECTRONICS 3 credits [3-0-0]

Prerequisites: EC 100: Basic Electronics

Design Concepts**:** Digital Hardware, Design Process, Hardware, Logic Circuit Design, Theory and Practice; Introduction To Logic Circuits**:** Variables and Functions, Inversion, Truth Tables, Logic Gates and Networks, Boolean Algebra, Systhesis using AND, OR AND NOT Gates, Design Examples, Introduction to Cad Tools, Introduction to VHDL.; Implementation Technology**:** Transistor Switches, NMOS Logic Gates, CMOS Logic Gates, Negative Logic System, Standard Chips, Programmable Logic Devices, Custom Chips, Standard Cells and Gate Arrays Practical Aspects, Transmission Gates, Implementation details for FPGAs.; Optimized Implementation of Logic Functions**:** Karnaugh Map, Strategy for Minimization, Minimization of Product-of-Sums Forms, Incompletely Specified Functions, Multiple-Output Circuits, NAND and NOR Logic Networks, Multi-Level Systhesis, Analysis of Multi-Level Circuits, CAD Tools. ; Number Representation And Arithmetic Circuits: Positional Number Representation, Addition of Unsigned Numbers, Signed Numbers, Fast Adders, Design of Arithmetic Circuits Using Cad Tools. ; Combinational Circuit Building Blocks: Multiplexers, Decoders, Encoders, Code Copnverters, Arithmetic Comparison Circuits, VHDL for Combinational Circuits. ; Flip-Flops, Registers And Counters, A Simple Processor: Basic Latch, Gated SR Latch, Gated D Latch. Master-Slave and Edge-Triggered D Flip-Flops, T Flip-Flop, JK Flip-Flop, Registers, Counters, Reset Synchronization, Other Types of Counters, Using Storage Elements with Cad Tools, Using Registers and Counters With Cad Tools, Design Examples. ; Synchronous Sequential Circuits**:** Basic Design Steps, State Assignment Problem, Meanly State Model, Design of Finite State Machines using CAD

Tools, Serial Adder Example, State Minimization, Design of a Counter using the Sequential Circuit Approach, FSM as an Arbiter Circuit, Analysis of Synchronous Sequential Circuits.

Essential Reading:

1. S. Brown and Z. Vranesis, *Fundamental of Digital Logic with VHDL design* Tata Mc GRAW-Hill, 2003

Supplementary Reading:

1. F. Vahid: *Digital Design:* Wiley Student Edition, 2006
2. J. F. Wakerly, *Digital Design Principles and Practices*, Fourth Edition, Prentice-Hall, 2005.
3. R. L. Tokheim, *Digital electronics, Principles and applications*, 6th Edition, Tata McGraw Hill Edition, 2003

EC 203 SIGNAL AND NETWORKS 4 credits [3-1-0]

RESONANCE IN AC CIRCUITS: Series and parallel resonance, Characteristics, Properties of resonant circuit, Selectivity, band width and Q factor. **COUPLED CIRCUITS**: Coefficient of coupling, Dot convention, Analysis of coupled circuits. **COMPLEX WAVES**: Fourier Series Representation, Evaluation of Fourier coefficients, Wave Symmetry, RMS values of Complex waves. **IMPEDANCE FUNCTION AND NETWORK THEOREMS**: The concept of complex frequency, Transform impedance and transform circuits, Series and parallel combinations, Super-position and reciprocity, Thevenin's Theorem and Norton's Theorem, Miller Theorem, Substitution, Compensation, Milliman, Maximum Power transfer theorem, Solution of Networks consisting of linear elements (Resistance, Inductance, Capacitance) with initial condition, Active elements like voltage and currrent sources, controlled sources by using loop variable, node voltage variable, Thevenin and Norton's method in transformed domain. ; **NETWORK FUNCTIONS, POLES AND ZEROS:** Network function for one port and two ports, Calculation of network functions like ladder networks, General Networks, Poles and zeros of network functions, Time domain behaviour from Pole and zero plot. **TWO PORT PARAMETERS (TRANSFORM DOMAIN):** Relation between two port network variables, Short circuit admittance, Open circuit impedance parameters, Hybrid parameters, Two generator equivalent circuit, One generator equivalent circuit, Transmission and inverse transmission parameters, Relation between parameter sets, Equalization of parameters of two port networks, Networks containing passive elements and controlled sources, Input and output impedance, transfer functions, Input output relationship, Voltage and current gain. ; **NON-SINUSOIDAL PERIODIC WAVEFORM:** Waveform Synthesis, response to non-sinusoidal periodic waveform, response of the circuit to the excitation with finite number of discontinuities **NETWORK SYNTHESIS:** Definition of positive real functions, Properties of positive real function, Properties of LC, RC and RL driving point function, Synthesis of LC, RC and RL driving point functions in FOSTER I & II and CAUER I & II forms.

Essential Reading:

1. V. Valkenburg, *Network Analysis* PHI, 1974
2. V. Valkenburg, *Network Synthesis* PHI

Supplementary Reading:

1. F. Kuo, *Network Analysis and Synthesis*

EC 204 SEMICONDUCTOR DEVICES 3 credits [3-0-0]

Prerequisites: EC 100: Basic Electronics

Semiconductor Crystals: Atomic Bond Model; Drift: Energy Bands, Ohm’s Law, Carrier mobility; Diffusion: Current equation, Einstein’s Relationship, Continuity equation; Generation & Recombination: Mechanisms, Minority Carrier Lifetime; P-N junction:

Principles, DC model, Capacitance of Reverse bias PN junction, store charge effects, Metal Semiconductor contacts: Schottky diode, Mos Capacitor; MOSFET: Principles, C-V Characteristics, Second order effects; BJT: Principles, C-V Characteristics, Second order effects; IC Technology: Diode in IC Technology, MOSFET Technologies; Bipolar IC Technologies; Photonic Devices: LEDs, Photo Detectors, Solar Cells, LASERs; Microwave FETs & Diodes; Power Devices: IGBT, Thyristors

Essential Reading:

1. S. Dimitrijev, *Principles of Semiconductor Devices:* Oxford University Press, 2005

Supplementary Reading:

1. Benman- *Introduction to Semi conductor Devices* – Cambridge. 2004
2. Dasgupta & Dasgupta, *Semiconductor Devices* **PHI, 2004**

EC 232 ELECTRICAL AND ELECTRONICS MEASUREMENTS 3 credits [3-0-0]

FUNDAMENTALS OF MEASUREMENT: Systems and Standards; GALVANOMETERS: Construction, Performance, Steady state and Dynamic Behaviors of d'Arsonval, Vibration, and Ballistic Galvanometers.; ELECTROMECHANICAL INDICATING INSTRUMENTS: *Ammeters and Voltmeters:* PMMC, Moving-Iron, and Electrodynamic type; *Ohmmeters:* Series-type and Shunt-type Ohmmeters; Thermo-instruments, Watt-hour Meters, Power-Factor Meters and Instrument Transformers; POTENTIOMETERS: DC and AC; BRIDGES: *D.C. Bridges:* Wheatstone bridge, and Kelvin bridge., *A.C. Bridges and their Applications:* Maxwell bridge, Hay bridge, Schering bridge, and Wein bridge, Measurement of high resistance by Megger; ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS: Amplified DC Meter, AC Voltmeter Using Rectifiers, True RMS–Responding Voltmeter, Electronic Multimeter, *Digital Voltmeters:*Ramp-type, Integrating type, and Successive-Approximation type; Component Measuring Instruments: Q-meter, Vector Impedance Meter, Vector Voltmeter, RF Power and Voltage Measurements.

Essential Readings:

1. E.W. Golding, F.C. Widdis – *Electrical Measurement and Measuring Instrument*, Wheeler Publishing, 2003
2. W.D. Cooper, A.D. Helfrick – *Modern Electronic Instrumentation and Measurement Techniques,* Pearson Education, 2007.

Supplementary Readings:

1. J B Gupta – *A course in Electrical and Electronic Measurements and instrumentation;* S K Kataria and Sons, 2003.
2. A.K. Sawhney - *A course in Electrical and Electronic Measurements and Inst.*, Dhanpat Rai & Sons, 2002

EC 270 BASIC ELECTRONICS LABORATORY 2 credits [0-0-3]

1. Familiarization with electronic components, and general purpose Laboratory equipment.
2. Use of CRO and function generator and calculation of amplitude, frequency, time period of different types of ac signals.
3. Verification of Junction Diode and Zener Diode characteristic and determination of static and dynamic resistance at the operating point
4. Verification of input and output characteristics of a Bipolar Junction Transistor and determination of the operating point ad load line.
5. Verification of input and output characteristics of a Field Effect Transistor and determination of the operating point ad load line.
6. Verification of Series and Parallel Resonance theory.

7. Operation of diode as different form of rectifier and effect of different types of passive filters on the output.
8. Determination of frequency response of passive high pass and low pass filters.
9. Determination of frequency response of a RC coupled amplifier and determination of bandwidth and signal handling capacity.
10. Verification of truth table for different types of Logic gates viz. AD, OR, NAND, NOR, NOT, EX-OR with 2/ 3/ 4 inputs.
11. Use of OP-AMP as an inverting and non-inverting amplifier for different gains.
12. Introduction to circuit analysis using p-spice through frequency response study of a RC filter.

EC 274 ANALOG ELECTRONICS LABORATORY 2 credits [0-0-3]

1. Design of 2 stage RC coupled amplifier.
2. Design of integrator and differentiator using OP-AMPS.
3. Design and verification of different amplifier configurations with OPAMPS.
4. Determination of different electrical parameters of OPAMP.
5. Design of OPAMP application circuits using P-SPICE simulator.

EC 276 DIGITAL ELECTRONICS LAB 2 credits [0-0-3]

1. Static and Dynamic Characteristic of NAND and Schmitt-NAND gate(both TTL and MOS)
2. Synthesis of a logic function by NAND gates only.(minimized and two level). Measurement of delay of the logic sp synthesized.
3. Design a clock by using NAND gates and R-C network as well as crystal.
4. Study the functionality of Multiplexer and using it design and implement a logic circuit.
5. Study the principle of a Demultiplexer and implement multi-output logic circuit.
6. Experiment on Serial-in, Parallel-in Serial-out right shift register with preset and clear. Generate maximally long linear sequence using this shift register and other necessary logic gates.
7. Study the dynamic characteristic of a J-K flip-flop and hence find out maximum operational frequency.
8. Design a ripple modulo counter and set-rest feedback method. Verify the states of count. Determine each stage delay and total delay. Determine the maximum clock frequency that it is able to count.
9. Design a sequential circuit and implement it by J-K flip-flops and other related logic gates.

EC 301 MICROPROCESSOR 3 credits [3-0-0]

Pre-requisite: EC 202: Digital Electronics

INTRODUCTION TO 16 BIT MICROPROCESSORS: Architecture of 8086 CPU Architecture, Internal operations, Machine Language instructions, Addressing mode, Instruction Format, Instruction execution timing, comparison of 8088 with 8086. ASSEMBLY LANGUAGE PROGRAMMING AND INSTRUCTIONS: Assembler instruction Format, Data Transfer, Arithmetic, Branch, Flag manipulation, Logical, Shift and Rotate, String Manipulation, Stack Manipulation, Call and return instructions, REP Prefix, Segment override prefix, and simple assembler directives such as label, Variable, DB , DW, DD, EQU, END, Assume, Pointer (byte, Word, Double Word, Near, Short, and Far). ; SYSTEM BUS STRUCTURE: Basic 8086/8088 configuration, Minimum Mode, Maximum Mode, System Bus timing, Interrupt Priority management with 8259 single and multiple. I/O PROGRAMMING: Fundamentals of I/O, Programmed I/O, Interrupt I/O, Block Transfer and DMA, I/O and memory configuration and design example. I/O INTERFACE: Serial communication interface using 8251, parallel

communication interface using 8255, Use of 8255 for A/D and D/A conversion with examples, Programmable timer and event counter using 8254, its application to ADC, Key board and display controller using 8279,; A SIMPLE PROCESS CONTROL MODEL USING 8086/8088 IN MAXIMUM AND MINIMUM MODE. ; ASSEMBLY LEVEL PROGRAMMING: Directives and operators, Linking and relocation, Near and far procedure, external identifiers and procedures. INTRODUCTION TO Multiprogramming. INTRODUCTION TO Multiprocessor configuration. INTRODUCTION TO 80286, 80386, 80486, 80586 (Pentium) MICROPROCESSOR Introduction, Architecture, internal operations, Addressing modes, instructions sets (brief)

Essential Readings:

1. W.A. Triebel and A. Singh, *The 8088 and 8086 Microprocessor Programming: interfacing Software and hardware applications, 2002, PHI*.
2. B.B. Brey, *The Intel microprocessor: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium processor, 2002, Pearson Education India*

Supplementary Readings:

1. Liu and Gibson; *Microprocessor Systems: The 8086/8088 Family: Architecture, Programming and design*; PHI

EC 311 ANALOG COMMUNICATION SYSTEMS 4 credits [3-1-0]

SPECTRAL ANALYSIS: Fourier series, Response of a linear system, Normalized power in a Fourier expansion, Power spectral density. The Fourier transform, Convolution, Parseval's theorem, Power and energy transfer through a network, Auto and Cross correlations. **RANDOM VARIABLES AND PROCESSES:** Probability, Mutually exclusive events, Joint probability, Statistical independence, Random variables, Probability density function, Average and variance. The Gaussian probability density. The error function, Mean and Variance of sum of random variables, Probability density of Z = X+Y. The Central limit theorem, correlation between random variables, auto correlation, power spectral density. **AMPLITUDE MODULATION SYSTEMS:** Frequency translation, Recovery of base band signal, Amplitude Modulation, Maximum Allowable Modulation. The square Law demodulator, Spectrum of AM signal, Balanced Modulator, SSB modulation and generation, VSB, FDM. **FREQUENCY MODULATION SYSTEM:** Phase and frequency modulation and their relationship, Frequency deviation, spectrum of FM Signal, BW of FM signal, Effect of modulation on BW, constant BW, FM phasor diagram, Narrow band FM, Armstrong and Parameter Variation methods of FM generation. FM Demodulators. **ANALOG TO DIGITAL CONVERSION**: Pulse Modulation Systems, Sampling theorem, Pulse Amplitude Modulation, Quantization of signals, Quantization error, Pulse code modulation (PCM) system, Companding, Time division multiplexing (TDM), DPCM, DM, ADM. **NOISE IN COMMUNICATION SYSTEM:** Resistor noise, Available power, Noise temperature, Noise bandwidth, Two ports Noise bandwidth, Input Noise temperature, Noise figure, Equivalent-Noise temperature of a cascade, An example of receiving system.

Essential Reading:

1. H. Taub, D. L Schilling, G. Saha; *Principles of Communication System, 3rd Edition; 2008, Tata McGraw Hill, India;* ISBN**:** 0070648115.

Supplementary Reading:

1. A.B. Carlson, *Communication system* - by Mc. Graw Hill.
2. G.P. John , S. Masoud; *Communication Systems Engineering,* Second Edition; 2002; PHI, India; ISBN :81-203-2750-0

EC 312 ELECTROMAGNETIC THEORY 3 credits [3-0-0]

Laplace and Poisson's equation, Solution of Laplace equation by separation of variables in Cartesian, cylindrical and spherical co-ordinates, cylindrical and spherical harmonics, Examples. ; Maxwell's equations for static fields, their modifications for time-varying fields conducting and dielectric media. ; EM Wave equations and uniform plane waves, in free space and in lossy medium, wave propagation in good dielectrics, in good conductors: Depth of penetration, Poynting vector and power flow, Reflection and refraction of EM Waves. ; Transmission lines: Transmission line equations, Parameters- primary and secondary constants, Reflection coefficient and SWR, Matched Transmission line, Impedance matching, Smith chart problems, Analogy of transmission lines with e.m. waves. ; Guided waves and Waveguides: Electric and magnetic fields in rectangular waveguide; TE, TM and TEM modes, Dominant modes, λ_c, λ_g, v_p, v_g, Numerical examples. ; Radio Wave Propagation: Modes of propagation, Structure of Troposphere, Tropospheric+-* Scattering, Ionosphere, Ionospheric Layers - D, E, F_1, F_2, regions. Sky wave propagation - propagation of radio waves through Ionosphere, Effect of earth's magnetic field, Virtual height, Skip Distance, MUF, Critical frequency, Space wave propagation.

Essential Reading:

1. N. Ida*, Engineering Electromagnetics, Springer,2004*
2. E.C. Jordan and K.G. Balmain, *Electromagnetic waves and Radiating systems, Prentice hall, 2004*

Supplementary Reading:

1. M. N. O. Sadiku, *Elements of Electromagnetics*- Oxford University Press, 2006
2. W. H. Hayt*, Engineering Electromagnetics, McGraw Hill, 2007*

EC 314 DIGITAL COMMUNICATION. 3 credits [3-0-0]

Prerequisites: EC 311: Analog Communication Systems

DIGITAL MODULATION TECHNIQUES: BPSK, BFSK and DPSK, QPSK, M-ary PSK, MSK, M-ary FSK, GMSK. **OPTIMUM RECEIVERS FOR AWGN CHANNEL**: Optimum receiver for signals corrupted by AWGN, performance of optimum receiver for memory less modulation, optimum receiver for CPM signals, optimum receiver for signals with random phase in AWGN channel. **CARRIER AND SYMBOL SYNCHRONIZATION:** Signal Parameter estimation, carrier phase estimation, symbol timing estimation, Joint estimation. **CHANNEL CAPACITY AND CODING**: Channel models and channel capacity, Block codes – coding and decoding, cyclic codes, algebraic codes, Reed-Solomon Code, Convolutional codes; **SPREAD SPECTRUM SIGNALS FOR DIGITAL COMMUNICATION:** Direct sequence (DS) spread spectrum and its applications, frequency hopping (FH) spread spectrum, synchronization of spread spectrum systems.

Essential Reading:

1. H. Taub and D.L. Schilling, *Principle of Communication Systems*, 2nd Ed., McGraw Hill, 1986.
2. J.G. Proakis, *Digital Communication,* McGraw-Hill Publications, 2000.

Supplementary Reading:

1. B. Sklar, *Digital Communications*, Pearson Education, India, 2001
2. J.G. Proakis, M. Salehi, *Communication Systems Engineering*, Pearson Education International, 2002
3. Lee & Moseschmitt, *Digital Communication,* Springer, 2004.

EC 316 MICROWAVE ENGINEERING 4 credits [3-1-0]

Prerequisites: EC 312: Electromagnetic Theory

Introduction: Microwave frequencies, Standard Frequency bands, Behaviour of circuits at Conventional and microwave frequencies, Microwave application, Review of Maxwell's equations; Waveguide: Overview of guided waves; TE, TM and TEM modes, circular wave guide, Choice of the type of waveguide dimensions, waveguide problems. ; Microwave Components & Devices : Scattering matrix and its Properties, coupling probes, coupling loops, windows, Waveguide tuners, Termination, E-plane Tee, H-plane Tee, Magic Tee, Phase-Shifter, attenuators, Directional coupler, Gunn diode, Microwave transistor MASER, Resonator and circulators. ; Microwave Generators: Transit-time effect, Limitations of conventional tubes, Two-cavity and multi-cavity Klystrons, Reflex Klystron, TWT and Magnetrons. ; Microwave Measurements : Power measurement; Calorimeter method, Bolometer bridge method, thermocouples, Impedance measurement, Measurement of frequency and wavelength, Measurement of unknown loads, Measurement of reflection coefficient, VSWR and Noise, Microwave test bench.

Essential Reading:

1. D M Pozar, *Microwave Engineering*, John Wiley & Sons, 2004
2. S Liao, *Microwave Devices & circuits*, Prentice halls, India, 2004

Supplementary Reading:

1. M L Sisodia, V. L. Gupta,; *Microwaves: Introduction to Circuits, Devices and* Antennas, New Age, 2001
2. R E Collin, *Foundations of Microwave Engg*. McGraw-Hill 2001

EC 322 EMBEDDED SYSTEMS 3 credits [3-0-0]

INTRODUCTION TO 8-bit and 16 bit microcontroller: 8051 family of microcontroller, architecture, memory organization, special function registers, timer counter, serial interface, interrupt organization, instruction sets and programming, instruction timing and interfacing, practical applications, introduction to 16-bit microcontroller 8096.
INTRODUCTION TO Embedded systems, Processor and memory organization, Devices and Buses for device networks, Device drivers and Interrupt servicing mechanism, Programming concepts and Imbedded programming in C and C++, Program modeling concepts in single and multiprocessor- development Process, Real time operating system.

Essential Readings:

1. R. Kamal; *EMBEDDED SYSTEMS Architecture, Programming and Design;* Tata McGraw-Hill Publishing Company Limited; 2003.
2. M.A. Mazdi & J.G. Mazdi; *The 8051 Microcontroller and Embedded System,* Pearson Education India, 2005.

Reference Readings:

1. K J Ayala; *The 8051 Microcontroller Architecture, Programming and Application*; Penram International Publishing (India), 2004.
2. T. D Morton; *Embedded Microcontrollers*; Pearson Education, India; 2003.

EC 331 CONTROL SYSTEMS ENGINEERING 4 credits [3-1-0]

INTRODUCTION; MATHEMATICAL MODEL: Mathematical representation of physical systems, Transfer function and impulse response of linear systems, Block diagram, Signal flow graphs; CONTROL SYSTEM COMPONENTS: Potentiometer, Synchros, LVDT, modulators, demodulators, ac servo motors, ac and dc tacho generators, HYDROULIC

SYSTEMS and PNEUMATIC SYSTEMS; GENERAL FEEDBACK THEORY: Feedback, The effect of feedback, Mathematical definition of feedback; TIME RESPONSE OF FEEDBACK CONTROL SYSTEMS: Typical test signal for the transient analysis, time domain performance characteristics, transient response, PI, PD Controllers, Tacho meter feedback, Steady state response, steady state error, The generalized error analysis, Stability, The Routh-Hurwitz criterion; THE FREQUENCY RESPONSE METHOD: Bode's Plot, Frequency domain specifications, M_P and ω_P for a second order system; THE NYQUIST CRITERION AND STABILITY: Nyquist criterion and the GH Plot, Relative stability, gain margin, phase margin, conditionally stable systems; THE ROOT LOCUS TECHNIQUE: Introduction, Root Locii, Root locus of conditionally stable systems; STATE VARIABLE ANALYSIS: Introduction, state, state variable and state model, State equations of continuous data control system, Derivation of state model from transfer functions and Vice-versa. Diagonalisation, solution of state equation.

Essential Readings:

1. K. Ogata, *Modern Control Engineering*, 2001, Prentice Hall of India,.
2. N. S. Nise, *Control system engineering*, 1992, John Wiley & Sons.

Supplementary Readings:

1. B.C. Kuo, *Automatic Control System,1995,* PHI
2. J. Diazzo and C.F. Houpis, Feed back *Control system analysis and synthesis.*

EC 332 ELECTRONIC INSTRUMENTATION 4 credits [3-1-0]

Pre-requisite: EC 100: Basic Electronics

REVIEW OF MEASUREMENTS AND ERROR: Definition, accuracy and precision, Significant figures, Types of error, Statistical analysis, Probability of error, limiting error; CATHODE RAY OSCILLOSCOPE: Introduction, Block diagram of CRO, cathode ray tube, CRT circuits, Vertical deflection system, delay line, horizontal deflection systems, Multiple trace, Oscilloscope probes and transducers, Measurements with CRO, special oscilloscope. ; SIGNAL GENERATION: Sine-wave generator, Frequency synthesized signal generator, Frequency divider generator, Sweep frequency generator, pulse and square wave generator, Function generators, Audio frequency signal generator, Digital and Analog Noise generator SIGNAL ANALYSIS: Wave analyser, Distortion analyser and spectrum analyser; FREQUENCY AND TIME INTERVAL MEASUREMENT: Simple frequency counter, measurement error, extending frequency range of counter, Automatic computing counter, Measurement of higher frequency by wave meter, heterodyne freq. meters; ANALOG AND DIGITAL DATA ACQUISITION SYSTEMS: Introduction, Signal conditioning of input, Single channel data acquisition systems, Multi channel data acquisition systems, Data conversion, A/D and D/A converters, Multi-plexers, Sample and hold circuits; INPUT OUTPUT DEVICES AND DISPLAY: Introduction, Analog displays and recorders, Digital I/O devices, Displays, Display multiplexing, Zero suppressing.

Essential Readings:

1. A.D. Helfrick, W.D. Cooper – *Modern Electronic Instrumentation and Measurement Techniques*, PHI, New Delhi, 2002.
2. D.A. Bell – *Electronic Instrumentation and Measurement,* PHI, New Delhi, 2003.

Supplementary Readings:

1. C.S. Rangan, G.R. Sarma and V.S.V. Mani - *Instrumentation Devices and Systems,*TMH, 2000
2. H.S. Kalsi – *Electronic Instrumentation,* TMH, 2000.
3. D. Patranabis- *Principles of Electronic Instrumentation*, PHI, 2008.

EC 334 INSTRUMENTATION DEVICES 4 credits [3-1-0]

THE GENERAL MEASUREMENT SYSTEM: Measurement System – Purpose, structure and elements. STATIC CHARACTERISTICS OF MEASUREMENT SYSTEM ELEMENTS: Systematic characteristics, Generalised Model of System element, statistical characteristics. THE ACCURACY OF MEASUREMENT SYSTEM IN THE STEADY STATE: Measurement error of a system of ideal elements. The error probability density function of a system of non-ideal elements. Error reduction techniques. DYNAMIC CHARACTERISTICS OF MEASUREMENT SYSTEMS: Transfer function for typical system elements, step and frequency response. Dynamic errors in measurement systems. Techniques for dynamic compensation. LOADING EFFECTS IN MEASUREMENT SYSTEM: Electrical loading, Generalised loading. SIGNAL AND NOISE IN MEASUREMENT SYSTEM: Statistical representation of random signals: Effects of Noise and interference on Measurement circuits, Noise sources and coupling mechanism, Method of reducing effects of Noise and interference. SENSING ELEMENT: Resistive (Potentiometers, Resistance Thermometer, Strain Gauges), Inductive (Variable reluctance, LVDT), Capacitive, Electromagnetive, Thermoelastic, Elastic, Piezoelectric, Photoelectric, Hall effect, Synchors and Resolvers, Digital Displacement Eddy current. SIGNAL CONDITIONING CIRCUITS: Potentiometer Circuit (Constant voltage and constant current), Wheatstone Bridge (Constant voltage and constant current).

Essential Readings:

1. J. P. Bentley, *Principles of Measurement System – Pearson Education*, Third edition, 2003.

Supplementary Readings:

1. J. W. Dally, W.F. Riley, K. G. McConnell - *Instrumentation for Engineering Measurements*, John Wiley, 2001.
2. J. B. Gupta – *A course in Electronic and Electrical Measurements and Instrumentation*, S.K. Kataria and Sons, 2000.

EC 336 INDUSTRIAL INSTRUMENTATION 4 credits [3-1-0]

Pre-requisite: EC 334: Instrumentation Devices

CHARACTERISTICS OF MEASUREMENT SYSTEMS: Introduction, Classification, Performance characteristics, Errors; PRESSURE MEASUREMENT: Basic methods, Measurement of mid-range pressures – U-tube manometer, Dead-weight gauge, Diaphragm, Bellows, Bourdon tube; Low-pressure measurement – Thermocouple gauge, Pirani gauge, Thermistor gauge, McLeod gauge, Ionization gauge; High-pressure measurement; TEMPERATURE MEASUREMENT: Introduction, Thermal expansion methods – Liquid-in-glass thermometer, Bimetallic thermometer, Pressure thermometer; Thermoelectric-effect instruments – Thermocouples; Varying-resistance devices – Resistance thermometers, Thermistors; Radiation thermometers – Optical pyrometers, Radiation pyrometers; FLOW MEASUREMENT: Introduction, Obstruction type flow meters, Variable-area flow meters, Positive-displacement flow meters, Turbine meters, Electromagnetic flow meters, Vortex-shedding flow meters, Ultrasonic flow meters; LEVEL MEASUREMENT: Dipsticks, Float systems, Pressure-measuring devices, Capacitive devices, Ultrasonic level gauge, Radiation methods, Hot-wire elements.

Essential Readings:

1. E.O. Doebelin – *Measurement Systems, Application and Design,* McGraw Hill International Edition, Singapore, 2003.
2. D. Patranabis – *Principles of Industrial Instrumentation,* Tata McGraw Hill, New Delhi, 2000.

Supplementary Readings:

1. B.C. Nakra and K.K. Chaudhury - *Instrumentation Measurement and Analysis*, Tata McGraw Hill Publishing Company Ltd., 2003.
2. A.K. Ghosh – *Introduction to Instrumentation and Control*, PHI, 2000.

EC 338 VIRTUAL INSTRUMENTATION 4 credits [3-1-0]

Pre-requisite: EC 334: Instrumentation Devices

FLOW MEASUREMENT SYSTEMS: Measurement of velocity at a point in a fluid, pitot-static tube, Measurement of volume flow rate: differential pressure, mechanical and vortex flow meters, Measurement of mass flow rate, inferential and direct methods, Measurement of flow rate in difficult situations: electromagnetic and cross-correlation flow meters. OPTICAL MEASUREMENT SYSTEMS: Introduction, types of systerm, Source: Principles, hot body, LED and Laser sources, Transmission medium: principles, optical fibers, Geometry of coupling of detector to source, Detectors and signal conditioning elements: thermal and photon detectors, Measurement systems: intensity and wave length modulation, interferometers. GAS CHROMATOGRAPHY: Principles and basic theory, typical gas Chromatograph, Signal processing and operations sequencing. DIGITALTIME MEASUREMENT TECHNIQUES: DIGITAL FREQUENCY MEASUREMENT TECHNIQUES: DIGITALLY PROGRAMMABLE CIRCUITS.

Essential Readings:

1. J.P. Bentley – *Principles of Measurement Systems*, Pearson Education, 3rd Edition, 2003.
2. T.S. Rathore – *Digital Measurement Techniques*, Narosha Publishing Home, 2001.

EC 341 DIGITAL SIGNAL PROCESSING 3 credits [3-0-0]

Introduction: Signals, systems and signal processing, concept of frequency in continuous and discrete time signal; **Discrete-time Signals and Systems:** Discrete time signals and systems, analysis of LTI system and implementation, correlation; **Z-transform:** Review, Analysis of LTI system in z-domain. ; **Frequency Domain Analysis:** Frequency analysis of continuous-time and discrete-time signals and LTI systems, LTI system as frequency selective filter, inverse system and de-convolution. ; **Discrete Fourier Transform:** Properties and Applications, Analysis using DFT; **Fast Fourier Transform Algorithms:** FFT algorithms and Applications, linear filtering approach to computation of DFT; **Implementation of Discrete-Time System:** FIR system, IIR system, representation of numbers, quantization of filter coefficients, round-off effects; **Design of Digital Filters:** Design of FIR and IIR filters, **Recent Developments.**

Essential Reading:

1. J.G. Proakis and D.G. Manolakis - *Digital Signal Processing: Principles Algorithms and Applications*, Pearson Education, 2005

Supplementary Readings:

1 A.V. Oppenheim, R.W. Schafer - *Digital Signal Processing*, Pearson Education, 2004
2 S.K. Mitra - *Digital Signal Processing: A computer based approach*, TMH, 2001
3. L. R. Rabiner and B. Gold – *Theory and Application of Digital Signal Processing,* Pearson Education, 2004

EC 370 EMBEDDED SYSTEM LAB 2 credits [0-0-3]

Microcontroller architecture. overall hardware architecture of microcontrollers, including busses, memories, and input/output subsystems. Application of timer and A/D subsystems to solve measurement and control tasks. Microcontroller interfacing. derive waveforms for serial communications interfaces. Apply microcontrollers and external circuitry to interface to a variety of sensors and actuators.

Applications:

- Traffic light control using micro controller.
- Stepper motor control using micro controller.
- Downloading and uploading from /on PC memory

Structured approach and developing an embedded system (Mini Project)

Initial Planning

Detailed hardware planning

- Software Development
- Instruction details
- Future Improvements

EC 371 MICROPROCESSOR LABORATORY 2 credits [0-0-3]

1. Arranging a set of date in ascending and descending order.
2. Finding out the number of positive, negative and zeros from a data set.
3. Transfer of data from one memory location to another memory location.
4. Searching the existence of a certain data in a given data set.
5. Gray – to – Binary and Binary – to – Gray conversion and BCD – to – Binary and Binary – to – BCD Conversion
6. Design a Up/down Counter.
7. Multiply two 8 Bit numbers using Successive addition and shifting method.
8. Add a series of unsigned 8- Bit data. Extend the experiment to add signed number and multi byte numbers.
9. Generate a Square wave and rectangular wave of given frequency at the output pin of 8255 chip.
10. Finding out 10's complement of a 4- digit BCD number.
11. Add a series of Decimal numbers.
12. Division of 8 Bit unsigned numbers by two. Division of a unsigned numbers by two.
13. Disassembling of the given 2 digit decimal number into two nibbles.
14. Transmission of series data by using SOD lines.
15. Generation of different types of analog signal using DAC.
16. Sampling of analog signal using ADC.
17. A small project work for construction of a display system/ real time digital clock.

EC 372 DIGITAL COMMUNICATION LABORATORY 2 credits [0-0-3]

1. To study Time division multiplexing.
2. To study PCM.
3. To study the different channel coding and decoding technique.
4. Generation and reception of different types of signals like ASK, PSK, FSK.
5. To transmit and receive three separate signal audio, video, tone simultaneously through satellite link.
6. To transmit PC data through satellite link using a satellite communication demonstration unit.
7. Experimentally compare different forms of BPSK, QPSK, OQPSK and analyze their spectrum with spectrum analyzer.

8. Spreading and dispreading using additive white Gaussian noise generation/ Gold code and other forms of spreading techniques.
9. Transmit different types of signals suing a ISDN system.
10. Analyze the process of data communication in LAN using LAN trainer and compare the performance different media access techniques.

EC 373 ANALOG COMMUNICATION LABORATORY 2 credits [0-0-3]

1. Study and design of AM modulator and demodulator. (Full AM, SSB, DSBSC, SSBSC)
2. Study of FM modulation and Demodulation Techniques.
3. Observer the process of quantization and determination of quantization noise.
4. Using MATLAB generate a carrier and a modulating signal Modulate the carrier using AM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
5. Using MATLAB generate a carrier and a modulating signal Modulate the carrier using FM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
6. Using Lab-View software simulate AM modulation and demodulation system.
7. Using Lab-View software simulate FM modulation and demodulation system.
8. Design a receiver to demodulate and receive the signal from a AM radio station.
9. Design a receiver to demodulate and receive the signal from the local FM radio station.

EC 374 INSTRUMENTATION DEVICE LABORATORY 2 credits [0-0-3]

1. Determination of Temp.-Resistance & Temp.—Voltage characteristics of the Thermistor.
2. Determination of Temp.-Resistance & Temp.—Voltage characteristics of the RTD (pt-100).
3. Determination of Temp. using Thermocouple with compensation & without compensation . Plot the graph for Actual Temp. vs %Error.
4. Determination of characteristics between strain applied & the voltage output, as well as the signal conditioned voltage of a cantilever strain gauge.
5. To study the characteristics of a LVDT with respect to secondary output voltage & Signal conditioned output voltage. Calibrate the LVDT & plot the graph between displacement & % Error.
6. To study the response of optical sensor by varying the distance from light source.
7. Study of PID controller.
8. Study of Temperature control system.

EC 375 DSP LABORATORY 2 credit [0-0-3]

1. Write a program for linear convolution of two sequences.
2. Write a program for circular convolution.
3. Write a program to perform linear convolution using circular convolution.
4. Write a program to perform N-point DFT. Also perform the IDFT on the result obtained to verify the result.
5. Write a program to perform circular correlation using
6. Direct method b) circular convolution using rotation method.
7. Write a program to perform circular convolution and correlation using DFT.
8. Write a program to perform linear convolution using (a)overlap save method (b) overlap add method.

9. Write a program to perform FFT on a sequence using the following methods. (a) Decimation in time (b) Decimation in frequency
10. Write a program to perform IDFT on a transformed sequence using DFT.
11. Write a program to design an FIR filter using windowing technique.
12. Write a program to design an IIR filter using (a) impulse invariant method (b) bilinear transformation method.

EC 376 VIRTUAL INSTRUMENTATION LAB 2 credit [0-0-3]

1. Water Level Control by PLC model IM-23.
2. Elevator Control by PLC model IM-20A.
3. Temperature Control by PLC Trainer model IM-30.
4. Performance analysis of Accelerometer.
5. To study the characteristics of the Hall effect through the Hall sensors.
6. Experiment based on Mechatronics Trainer System.
7. Experiments on PLC Trainer Model VPLCT-02S.

EC 378 MICROWAVE LAB 2 credit [0-0-3]

Using Gunn Oscillator Based Microwave Test bench:

1. Study of Gunn Oscillator
2. Study of Frequency, Guide wavelength
3. Measurement of VSWR, Reflection coefficient, Impedance measurement
4. Study of Directional coupler
5. Study of Variable Attenuator

Using Microwave Test bench for Antenna Measurement:

To plot the polar pattern & gain characteristics of the following Antennas

1. Pyramidal Horn
2. Pickup Horn
3. Slotted Horn
4. Slotted Wave Guide Antenna
5. Dielectric Antenna
6. Sectorial Horn (E&H-Plane)
7. Parabolic Dish

Using IE3D & WIPLD Electromagnetic Simulator:

Simulation of Microstrip patch Antenna to study the following parameters

1. Impedance Plot
2. Radiation pattern
3. Bandwidth
4. S-parameters(S_{11},S_{12},S_{22} etc)
5. Gain
6. Efficiency

EC 380 CONTROL SYSTEM LAB 2 credit [0-0-3]

1. Evaluate the effect of pole and zero location on the time response of first and second – order systems.
2. Evaluate the effect of additional pole and zeros on the time response of second-order systems.
3. Verify the equivalency of the basic forms, including cascade, parallel and feedback forms. To verify the equivalency of the basic moves, including moving blocks past summing junctions and moving blocks past pickoff points.
4. Verify the effect of pole location upon stability of a system. Extend the experiment to check the stability with negative feedback.

5. Verify the effect of input waveform, loop gain and system type upon steady-state errors.
6. See the effect of open-loop poles and upon the shape of the root locus. Also verify the root locus as a tool for estimating the effect of open-loop gain upon the transient response of closed-loop systems.
7. To perform a trade-off study for lead compensation. To design a PI controller and see its effect upon steady- state error.
8. To examine the relationships between open-loop frequency response and stability, open-loop frequency response and closed-loop transient response and the effect of additional closed-loop poles and zeros upon the ability to predict closed-loop transient response.
9. To design a PID controller using MATLAB's SISO design tool. Observe the effect of a PI and a PD controller upon the magnitude and phase responses at each step of the design of a PID controller.
10. To simulate a system that has been designed for transient response via a state-space controller and observer.
11. Design the gain of a digital control system to meet a transient response requirement; to simulate a digital control system to test a design and observe the effect of sampling rate upon the time response of a digital system.

EC 382 COMMUNICATION DESIGN LAB 2 credit [0-0-3]

1. Design a AM transmitter and receiver system using p-spice and test the circuit designed using discrete components.
2. Design a FM transmitter and Receiver system using p-spice and test using discrete components.
3. Design a 10m FM transmitter using available ICs and receive the transmitter signal using a commercial FM receiver.
4. Design a PCM system to transmit voice signal. Include multiplexing of 8voice channels for the purpose and design the receiver side also.
5. Design a delta modulator for voice signal transmission.

EC 410 ANTENNA ENGINEERING 3 credits [3-0-0]

Prerequisites: EC 312: Electromagnetic Theory

Electromagnetic fields and its radiation: Maxwell's equations, EM Waves, Plane wave equation and its solution for free space and non-conducting medium. **Structures of Antennas:** Antenna Definition, size, supports, feeders, conductors & insulators. **Antenna Parameters**: Isotropic radiator, Radiation resistance, Antenna resistance, Bandwidth, Beamwidth, Radiation pattern, Radiation intensity, Gain - Power gain Directive gain, Directivity, Antenna aperture, Efficiency, Effective aperture, effective length, Polarization, Voltage and Current relations. **Practical Antennas:** VLF & LF transmitting antennas, Medium frequency and High frequency antennas, Long wire, Rhombic, V, Folded - dipole, Yagi, Horn and Parabolic reflector. **Planar Antenna:** Microstrip Antenna, Radiation Principle, Input impedance, Bandwidth, Feeding techniques, TL model, Cavity Model, Parameter calculation using IE3D software.

Essential Reading:

1. C Balanis, *Antenna theory, analysis and design*, 2nd. Edn., John Wiley & Sons,

Supplementary Reading:

1. E.C. Jordan & K.G. Balmain, *Electromagnetic waves and Radiating Systems.*
2. R. Chatterjee, *Antenna Theory and Practice* - New age Publisher, 2004
3. J. D. Kraus, *Antenna*- Tata McGraw Hii, 2006

EC 412 ANTENNA ANALYSIS & SYNTHESIS 4 credits [3-1-0]

Pre-requisite: EC 312: Electromagnetic Theory

Design of short wire antenna, Calculation of field pattern for odd and even Half- wavelengths Antenna Array, Linear array, Phased array; Array synthesis: Prediction of antenna array from radiation pattern, Detailed theoretical analysis of: Yagi-Uda array; Theory of: Horn antenna, Parabolic antenna, satellite antenna; Design of Microstrip antenna (Rectangular & square patches); Idea about Transmission Line Model; Brief idea about Active Integrated antenna

Essential Reading

1. C.A. Balanis, *Antenna Analysis.*

Supplementary Reading

1. Jordan & Balmain, *Electromagnetic Waves and Radiating Systems.*
2. J. D. Kraus, *Antenna Theory.*

EC 413 OPTICAL COMMUNICATION 4 credits [3-1-0]

Introduction to optical communication: Characteristics of optical transmission media, optical fibres- preparation and transmission characteristics, loss and dispersion mechanisms; **Optical sources:** principles of operation, modulation characteristics and driver circuits, LED, laser diodes, light source linearity, modal, and partition and reflection noise**; Power Launching and Coupling:** Source to fibre power launching, lensing schemes for coupling improvement, fibre to fibre joints, couplers, multiplexers and splices; **Photo detectors**: principles of operation, circuits and performance, preamplifiers and post-detection amplifiers; **Optical Fiber systems**: intensity modulation/direct detection system, link budget using direct detection, coherent system, wavelength converters, coherent and WDM systems, Photonic switching.

Essential Reading:

1. G. Keiser, *Optical Fibre Communications*, McGraw Hill, 2008.
2. John M. Senior, *Optical Fiber Communications: Principles and Practice*, PHI, 2008.

Supplementary Reading:

1. Jones, William B. Jones, *Introduction to Optical Fiber Communications Systems*, Oxford University Press (1995)
2. A. J. Rogers, *Understanding Optical Fiber Communications*, Artech House (2001)
3. J. C. Palais, Fiber optic communication, 5th edition, Prentice Hall, 2004

EC 414 INFORMATION THEORY AND CODING 4 credits [3-1-0]

Introduction: Entropy and mutual information, source coding, variable length coding, discrete memory less channels, capacity cost functions, channel coding, linear block codes, and cyclic codes. Convolution codes, sequential and probabilistic decoding, majority logic decoding, burst error-correcting codes, turbo codes and low-density-parity-check codes; rate distortion theory: rate distortion function. **Cryptography**: basic concepts on cryptography and cryptoanalysis, security issues; private-key encryption algorithms-stream ciphers, block ciphers, Shannon's theory; introduction to number theory - modular arithmetic, exponentiation and discrete logarithms in Galois field; public-key encryption algorithms-Diffie-Hellman public-key distribution scheme, RSA public-key cryptosystem; Message authentication, hashing functions, digital signatures.

Essential Reading:

1. S. Haykin, *Communication Systems*, 4th Ed, John Wiley & Sons, New York, 2001.

2. L. Hanzo, T.H. Liew and B.L. Yeap, *Turbo coding, turbo equalization and space-time coding for transmission over fading channels*, John Wiley &Sons, 2002

Supplementary Reading:

1. Wade Trappe, Lawrence C. Washington, *Introduction to Cryptography with Coding Theory*, Second edition, Prentice-Hall, Inc. NJ, USA.
2. R. Bose, *Information Theory, Coding and Cryptography*, Tata McGraw-Hill, 2002.
3. B.P. Lathi, *Modern digital and Analog communications,* Third Edition, Oxford University Press
4. Douglas R. Stinson, Cryptography*: Theory and Practice*, Third Edition, Champmen & Hall/ CRC

EC 415 MOBILE COMMUNICATION 4 credits [3-1-0]

Evolution, Mobile Systems around the World, Example of the mobile radio systems, recent trends, Frequency reuse, Channel assignment, hand off process, Interference. Path less:– Radio wave propagation, diffraction, Scattering, link budget; Outdoor and indoor propagation models; Principle of multi path propagation, Impulse response model of channels, parameters for mobile multi path channels, concept of fading, Rayleigh and Ricean fading; simulation of fading channels. Modulations techniques for mobile communication:- Linear Modulation techniques, constant envelop modulation, QPSK, MSK, GMSK, spread spectrum modulation techniques. Equalization:- Fundamentals, General adaptive equalizer, Linear and non-linear equalizers, diversity techniques, RAKE receivers. Basic concept of coding. Multiple access techniques:- Introduction, FDMA, TDMA, CDMA, Space division multiple access, capacity of cellular systems. Introduction to OFDM and wireless LAN.

Essential Reading:

1. T.S. Rappaport, *Wireless Communications – Principles and Practice*, Prentice Hall of India/ Pearson Education India, 2002.
2. W C Y Lee; *Mobile Communication Engineering*, Tata McGraw Hill, India, 2008

Supplementary Reading:

1. W.C.Y. Lee, *Digital Cellular Systems*, Mc Graw Hill, 2000.
2. G. Stuber; *Principles of Mobile Communication*, 2001, Springer

EC 417 SATELLITE COMMUNICATION 4 credits [3-1-0]

Introduction: Original Satellite Communications, History, Current State, Overview of Satellite System Engineering; **Orbital Aspects of Satellite Communication:** Orbital mechanism, look angle determination, orbit determination, orbit effects on Communication, System performance; **Satellite Link Budget:** Basic transmission theory, system noise and G/T ratio, down link design, satellite system using small earth station, up-link design; **Modulation Multiplexing Techniques:** Analog telephone transmission, Television transmission, Digital transmission, Digital TV and bandwidth Compression, time division multiplexing; **Multiple Access Techniques:** Frequency division multiple access, time division multiple access, code division multiple access, practical demand access systems, random access, multiple access with on-board processing; **Satellite Earth Solution Techniques:** Earth solution design, tracking, small earth station antennas, Equipment for the Earth station.

Essential Reading:

1. T. Pratt and W. Boston, *Satellite Communications,* John Wiley & Sons, 2004
2. William W Wu, Elements of Digital Satellite Communication, Vol. 1, Computer Science Press 2006.

Supplementary Reading:

1. T.T. Ha, *Digital Satellite Communications,* McGraw Hill, U.S.A., 2004
2. G.D. Gordon, W.L. Morgan, *Principles of Communication Satellite,* John Wiley & Sons, U.S.A., 2005

EC 419 COMPUTER COMMUNICATION NETWORKS 4 credits [3-1-0]

Communication Model, Data Communications, Computer Communication Architecture, Standard Making Organisations. Concepts and Terminology, Asynchronous and Synchronous Data Communications, Multiplexing Techniques. Communication Networking Techniques, Circuit Switching, Packet Switching, Local Area Networks. Protocols, Layered Approach, TCP / IP Protocol Suite, System Network Architecture. The Bridge and Routing, Connectionless internetworking, Connection oriented internetworking. Transport and Network Services TCP / UDP. Session Characteristics, OSI Session and Service Protocol. Presentation Concepts, Encryption and Authentication Codes, Virtual Terminal Protocols. Network Management, File Transfer and Electronic Mail. Communication Switching Techniques, Frame-mode Bearer Service, Frame Relay Congestion Control, Synchronous Transfer Mode.

Essential Reading

1. W. Stallings, *Data and Computer Communications*, PHI, New Delhi, 2006

Supplementary Reading

1. A.S.Tanenbaum, *Computer Networks*, 2nd Ed.; PHI, New Delhi, 2002.
2. F. Halsall, *Data Communications, Computer Networks and Open Systems*, Pearson Education, 2003

EC 421 DIGITAL VLSI DESIGN 4 credits [3-1-0]

Introduction to VLSI Design, Levels of abstraction and the complexity of design, Challenges of VLSI design: power, timing, area, noise, testability, reliability and yield ; CAD tools: simulation, layout, synthesis, test; MOS modeling, MOS device models, Short-channel effects and velocity saturation, Scaling of MOS circuits; VLSI fabrication technology, Layout design, Design rules, Stick diagrams; The CMOS inverter, VTC, Switching behavior, Noise margins and power dissipation; Static and dynamic CMOS combinational logic gate, Transistor sizing in static CMOS, logical effort , Pass-transistor logic, sizing issues , Domino logic gates , estimating load capacitance , Simple delay models (RC) for CMOS gates , Power consumption; Latches and clocking, Flip-flops, Set-up and hold tests, Static and dynamic latch and flip-flop, Clock design; Datapath units, Adders, Shifters, Multipliers; Control logic strategies, PLAs , Multi-level logic, Synthesis and place-and-route CAD; MOS memories , Register, SRAM , DRAM; Global interconnect modeling, Capacitance, resistance and inductance of interconnect; Signal and power-supply integrity issues, Electromigration, RC interconnect modeling Driving large capacitive load, reducing RC delays; Layout design, Standard-cell layout, Chip layout and floor planning, Array layout; Implementation issues, Design for testability, Packaging technology, I/O issues: ESD protection, boundary scan, inductance, synchronization

Essential Reading

1. J. M. Rabaey, A. Chandrakasan and B. Nikolic, *Digital Integrated Circuits: A Design Perspective*, Second Edition, Pearson/PH, 2003. (Cheap Edition)

Supplementary Reading

1. J. P. Uyemura, *Introduction to VLSI Circuits and Systems*, Wiley, 2001.
2. W. Wolf, *Modern VLSI Design: Systems-on-Chip Design*, Third Edition, Pearson/PH, 2002. (Cheap Edition)

3. R. L. Geiger, P. E. Allen and N. R. Strader, *VLSI Design Techniques for Analog and Digital Circuits*, McGraw-Hill, 1990.

Prerequisites: Must have taken EC 201, EC 202

EC 423 HDL AND HIGH LEVEL VLSI DESIGN 3 credits [3-1-0]

Prerequisites: EC 202: Digital Electronics

Basic concepts of hardware description languages., Hierarchy, Concurrency, logic and delay modeling, Structural, Data-flow and Behavioral styles of hardware description, Architecture of event driven simulators, Syntax and Semantics of VHDL, Variable and signal types, arrays and attributes, Operators, expressions and signal assignments, Entities, architecture specification and configurations, Component instantiation, Concurrent and sequential constructs, Use of Procedures and functions, Examples of design using VHDL., Synthesis of logic from hardware description. ; CMOS Process and Masking Steps: Concept of Lambda, Design Rules, Layer Properties and Parasitic Estimation, Sheet Resistance, U Cg, Capacitance Ratio for Layers, Concept of tau, Quick estimation of delays. Design of Buffers and I/O Pads, CMOS Logic Design Styles and their Comparison, CMOS Logic Design Styles and their Comparison (Continued), From Specifications to Silicon, Abstraction Levels in VLSI Design. ; Adder Architectures, Multiplier Architectures, Counter Architectures, ALU Architectures. Latches, Flip-flops, Registers and Register Files. PLA Design, Gate Array Approach, Standard Cell Approach. Moore and Mealy Machines, PLA-based Implementation, Random Logic Implementation, Micro-programmed Implementation (ROM-based Implementation) SRAM Cell, Different DRAM Cells, Arraying of Cells, Address Decoding, Read / Write Circuitry, Sense Amplifier Design, ROM Design. Clock Skew, Clock, Distribution and Routing, Clock Buffering, Clock Domains, Gated Clock, Clock Tree.

Essential Reading:

1. C. H. Roth, *Digital Systems Design Using VHDL* , Thomson Publications, Fourth Edition, 2002
2. V. A. Pedroni, *Circuit Design with VHDL*, MIT Press/PHI, 2004. (Cheap Edition)

Supplementary Reading:

1. Z. Navabi, *Verilog Digital System Design*, Second Edition, Tata McGraw-Hill, 2008.
2. R. C. Cofer and B. F. Harding, *Rapid System Prototyping with FPGAs: Accelerating the Design Process*, Elsevier/Newnes, 2005.

EC 424 EMBEDDED COMPUTING SYSTEMS 3 credits [3-1-0]

Microcomputer-based Systems, Software Development, Interfacing Methods, Interrupt Synchronization, Threads, Timing Generation and Measurements Serial I/O Devices, Parallel Port Interfaces, Memory Interfacing, High Speed I/O Interfacing Analog Interfacing Data Acquisition Systems, Microcomputer-based Control Systems Simple Networks, Digital Filters. ; **Circuits and DSP Architectures:** Circuit design basics, deep submicron issues, low architectures for embedded systems. ; **Architecture Design:** Embedded processor architectures, Architectural techniques for low power, Design methods for core based ASICs. ; **Compiler and OS:** Introduction to compiler optimizations, Power models for compiler optimizations, Code size vs. performance / power trade offs. ; **DSP Algorithm Design:** A/D conversion and finite precision analysis, Algorithms for embedded systems: source and channel processing, Portable embedded code. ; **Networking:** Networking basics (addressing and routing), Wireless vs. wire-line networking, Distributed OS for networked embedded systems: Case study of JINI. ;

Essential Reading:

1. W. Wolf, *Computers as Components : Principles of Embedded Computer System Design*, Second Edition, Elsevier/MK, 2005
2. F. Vahid and T. Givargis, *Embedded System Design: A Unified Hardware/Software Introduction*, Wiley, 2002.

Supplementary Reading:

1. P. Marwedel, *Embedded System Design*, Springer, 2006.
2. Proceedings of the IEEE (Special Issue on HW/SW Codesign), March, 1997.

EC 431 PC BASED INSTRUMENTATION 3 credits [3-0-0]

Pre-requisite: EC 100: Basic Electronics

Introduction, Signal-conditioning and op amp circuits, Sensors and actuators, Principles of data acquisition, Hardware organization of IBM PC, Interfacing to IBM PC, Plug-in data acquisition and control boards, Data acquisition using GPIB, Data acquisition using serial interfaces, Networked data acquisition, Recent developments.

Essential Readings:

1. N. Mathivanan – *PC-based Instrumentation: Concepts and Practice,* PHI, 2008.

EC 432 BIOMEDICAL INSTRUMENTATION 3 credits [3-0-0]

Pre-requisite: EC 336: Industrial Instrumentation

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION: Biometrics, Introduction to the man-instrument system, Components of the man-instrument system, Problems encountered in measuring a living system; BIO-ELECTRIC SIGNALS AND ELECTRONICS: Origin of bio-electric signals, Bioelectric potentials, Biopotential electrodes; PHYSIOLOGICAL TRANSDUCERS: Pressure transducers, Transducers for body temperature measurement, Pulse sensors, Respiration sensors; BIOMEDICAL RECORDERS: Electrocardiograph, Phonocardiograph, Electroencephalograph, Electromyograph; PATIENT MONITORING SYSTEM: System concepts, Measurement of heart rate, Blood pressure measurement, Measurement of temperature, Measurement of respiration rate, Apnoea detectors; BLOOD FLOW METERS: Electromagnetic blood flow meter, Ultrasonic blood flow meter, NMR blood flow meter, Laser Doppler flow meter; BLOOD GAS ANALYZERS: Blood pH Measurement, Blood PCO_2 measurement; BLOOD CELL COUNTERS: Method of cell counting, Coulter counters, Automatic recognition and differential counting of cells; RECENT DEVELOPMENTS.

Essential Readings:

1. L. Cromwell, F.J. Weibell, E.A. Pfeiffer, *Biomedical Instrumentation and Measurements,* Pearson Education, Delhi, 2005.
2. R.S. Khandpur, *Handbook of Biomedical Instrumentation,* Tata Mc Graw Hill, New Delhi, 2000.

Supplementary Readings:

1. J.G. Webster, *Bioinstrumentation,* Wiley Student Edition, 2004.
2. W.J. Tompkins, *Biomedical Digital Signal Processing*, PHI India Pvt. Ltd., 2008.

EC 433 PROCESS CONTROL INSTRUMENTATION 3 credits [3-0-0]

Pre-requisite: EC 331: Control System Engineering

INTRODUCTION TO PROCESS CONTROL: A Process Control System, Important terms and the objectives of Automatic Process Control, Transmission Signals, Control Strategies; MATHEMATICAL TOOLS: Deviation variables, Linearization of functions of one variable, Linearization of functions of two or more variables; FIRST-ORDER DYNAMIC SYSTEM: Thermal Process, Gas process, Dead time, Level process, Response of first-order processes; HIGHER-ORDER DYNAMIC SYSTEMS: Tanks in series – Noninteracting systems, Interacting systems, Thermal process, Response of higher order systems; BASIC COMPONENTS OF CONTROL SYSTEM: Sensors and Transmitter, Control Valves, Feedback controllers (P, PI, PID); DESIGN OF SINGLE-LOOP FEEDBACK CONTROL SYSTEMS: Feedback control loop, Stability of the control loop, Tuning of feedback controllers, Synthesis of feedback controllers.

Essential Reading:

1. C. A. Smith & A. B. Compio - *Principles and Practice of Automatic Process Control,* John Wiley, 2004.

Supplementary Readings:

1. D.E. Seborg, T.F. Edgar and D.A. Mellichamp – *Process Dynamics and Control*, John Wiley and Sons, 2004.
2. W.L. Luyben and M.L. Luyben – *Essentials of Process Control*, McGraw-Hill International Edition, 2002.

EC 434 ANALYTICAL INSTRUMENTATION 3 credits [3-0-0]

Pre-requisite: EC 334: Instrumentation Devices

Statistical techniques:-Error analysis, distribution, confidence level, least square fitting, testing of hypothesis. Measurement of viscosity, humidity and thermal conductivity. Mass Spectroscopy. Gas Chromatography:- Principles and construction, detectors, Industrial gas chromatograph, Liquid chromatography. Ionising electrodes: -pH and ion sensitive electrodes, ISFET and chemical sensors. Absorption spectroscopy:-IR and UV spectroscopy. Non-dispersive technique of measurement; UV fluorescence spectroscopy. Emission Spectroscopy: Flame and atomic emission spectroscopy. X-ray methods of measurement: sources and detectors, X-ray absorption and florescence techniques. Chemical analysis of surface- Ion scattering spectroscopy, Auger Emission spectroscopy, ESCA. Nuclear Magnetic resonance Spectroscopy: Basic principle and its application. Environment and Pollution monitoring Instruments; Recent developments.

Essential Readings:

1. H.W. Willard, L.L. Merritt, J.A. Dean, F.A. Settle – *Instrument Method of Analysis,* East West Publishers, 2002.
2. C. Wiston – *X-ray Methods,* John Wiley and Sons, 2000.

Supplementary Readings:

1. D.A. Strong, F.J. Holler, T.A. Nieman – *Principles of Instrumental Analysis,* Saunders, 2003.

EC 437 RADAR ENGINEERING 3 credits [3-0-0]

Introduction: Principle of detection and ranging, Radar frequencies and bands. Applications, Radar block diagram and operation. ; Radar Range Equation: Range prediction, Minimum detectable signal, Receiver noise SNR, Noise temperature, Pattern propagation factor, Antenna gain, Loss factors, Jamming & Clutter, Accuracy of prediction. Integration of radar pulses, Radar cross section of targets, Transmitter Power, PRF and system losses & Propagation effects ;Automatic Detection, Tracking and Sensor integration: Optimal detector,

Target resolution, Automatic Tracking, Tracking while-scan system, Multi sensor integration, Maximum Likelihood Approach; CW FM Radar: Doppler Effect, CW Radar, Frequency-modulated CW Radar, Multiple-frequency CW Radar. ; MTI and Pulse Doppler Radar: MTI delay lines, Delay line cancellers, Coherent and Non-Coherent MTI, Pulse Doppler Radar, Electronic Scanning Radar: Principle of Electronic Scanning by Phase, Frequency and switching Techniques, Linear array and beam steering, Planar arrays and Beam steering, Basic description of phased array Radar system, Generalized performance of a phase antenna system; Pulse Compression Technique: Pulse compression system, Linear FM, Non linear FM, Digital Pulse compression, Phase coded Waveforms, Optimal Binary Sequence. Time-frequency, Coded waveforms, Weighting & Equalization.

Essential Readings:

1. M.I. Skolnik, *Radar Hand Book*, McGrawhill, 2008
2. Francois Le Chevalier, *Principles of Radar and Sonar Signal Processing*, Artech House, 2002

Supplementary Readings:

1. M.I. Skolnik - Introduction to Radar Systems, McGraw Hill, 2004
2. G. Stimson, Introduction to Airborne Radar, IEE Press, 2002

EC 442 ADVANCED TECHNIQUES IN DSP 4 credits [3-1-0]

Prerequisites: Digital signal Processing

Multi-rate Digital Signal Processing: Decimation by a factor D, interpolation by a factor 1, sampling rate conversion by a national factor I/D. ; Sampling rate conversion of band pass signals. ; Implementation of low pass filter and digital filter banks. ; lattice filters, Linear prediction, forward and backward linear prediction, FIR wiener filter. ; Power spectrum estimation, non-parametric method Barlett, Parametric method. ; Yule-Walker MA and ARMA models. Higher order statistics and its applications. ; DSP transforms: Discrete Hartely transform, Discrete consine transform, Discrete Wavelet transform, S-transform. DSP techniques for bioinformatics., recent topics

Essential Reading

1. J.G. Proakis, D.G. Manolakis, *Digital Signal Processing,* PHI, New Delhi, 1995.
2. S.J. Orfanidis, *Optimum Signal Processing,* Mac Millan Publishing Co., USA, 1985.

Suggested reading

1. C.K. Chui, *An Introduction to Wavelets,* Academic Press, USA, 1992.
2. Guoan Bi and Yonghong Zeng, Transforms and Fast Algorithms for signal analysis and representations, Springer, NY, USA, 2003
3. Lecturer notes

EC 443 DIGITAL IMAGE PROCESSING 3 credits [3-0-0]

Prerequisites: EC 341: Digital signal Processing

INTRODUCTION: Fundamental steps in digital image processing, Components of an image processing system, DIGITAL IMAGE FUNDAMENTALS: Image sampling and quantization, Some basic relationships between pixels, Linear and nonlinear operations, IMAGE ENHANCEMENT IN SPATIAL DOMAIN: Some basic gray level transformations, Histogram processing, Smoothing and Sharpening spatial filters, IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Smoothing and Sharpening frequency domain filters, Homomorphic filtering, IMAGE RESTORATION: Noise models, Restoration in the presence of noise only-spatial filtering, Estimating the degradation functions, Inverse filtering, COLOR IMAGE

PROCESSING: Color models, Pseudo-color processing, IMAGE COMPRESSION: Image compression models, Loss-less and Lossy compression, MORPHOLOGICAL IMAGE PROCESSING: Dilation and erosion, Opening and closing, Some basic morphological algorithms, IMAGE SEGMENTATION: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation, RECENT DEVELOPMENTS**.**

Essential Reading:

1. R. C. Gonzalez and R.E. Woods - *Digital Image Processing*, Pearson Education, 2006
2. L. R. Rabiner and R.W. Schafer - *Digital Processing of Speech Signals*, Pearson Education, 2005

Supplementary Readings:

1. K. Jain - *Fundamentals of Digital Image Processing*, Pearson Education, 2007
2. L. R. Rabiner and B. Gold – *Theory and Application of Digital Signal Processing,* Pearson Education, 2004

EC 444 SOFT COMPUTING 4 credits [3-1-0]

Fundamental Concepts:- Introduction to Artificial Neural Networks (ANN). Learning Process:- error–correction learning, Hebbian learning, competitive learning, Boltzmann learning, the credit-assignment problem, supervised learning, and other learning techniques. Single neuron/ Perceptron networks:- training methodology, typical application to linearly separable problems. Multilayer Perceptron:- Back propagation algorithm, virtues and limitation of BP algorithm, modifications to back-propagation. Radial-basis function Networks – interpolation problem, Covers theorem, regularization networks, applications. Recurrent Networks. ; Introduction to Fuzzy systems, Membership function, Fuzzy relational operation, fuzzy IF THEN rules, Sugeno and Mamdani type systems, Adaptive Neuro-Fuzzy sytems, training methods Application of ANN and Fuzzy systems to non-stationary time series prediction; pattern classification; control; communication engineering; system identification and pattern classification.

Essential Reading:

1. S. Haykin, *Neural Networks - A Comprehensive Foundation;* Pearson Education, India (The book is also published by Prentice Hall of India), 2008 (ISBN- 81-203-2373-4).
2. M.T. Hagan, Howard B. Demuth, Mark H. Beale; *Neural Network Design*; (ISBN: 0-9717321-0-8); Thomson 2002
3. Jang, Sun and Mizutani; *Neuro-Fuzzy and Soft-Computing – A computational approach to learning and machine intelligence*; Prentice Hall of India; ISBN-81-203-2243-6

Supplementary Reading:

1. S. Kumar; *Neural Networks: A Classroom approach*, Tata Mcgraw Hill, 2004, ISBN: 9780070482920

EC 446 ADAPTIVE SIGNAL PROCESSING 4 credits [3-1-0]

Prerequisites: Digital signal Processing

Adaptive systems: Examples and applications. Adaptive linear combiner : the performance function, gradient and minimum mean square error, alternative expression of gradient, LMS, NLMS, sign-error, sign-data and FXLMS algorithms, transform domain LMS, Recursive least square algorithm, windowed RLS, computational complexity, Block adaptive filter(time and

DFT domains), adaptive lattice filters, IIR adaptive filter : equation error form. Adaptive filtering, adaptive channel equalization, Adaptive line enhancement and adaptive system identification. Hardware implementation of digital adaptive filter. Applications of adaptive filter : 50Hz interference in electrocardiography, cancellation of donor-heart interference, cancellation of maternal ECG in electrocardiography, cancellation noise in speech signals, adaptive echo cancellation in long distance telephone line, self tunning filter. Adaptive control systems : model inverse and model reference controls. Introduction of adaptive array and adaptive beam forming. Recent advances in adaptive filtering.

Essential readings

1. S. Haykin and T. Kailath, *Adaptive Filter Theory,* Pearson Education, 4th Edition, 2005.
2. B. Widrow and S. D. Sterns, *Adaptive Signal Processing*, Pearson Education, 2nd Indian reprint, 2002.

Suggested reading

1. Lecturer notes

EC 448 EVOLUTIONARY COMPUTING 4 credits [3-1-0]

Genetic Algorithm : Basic concepts, Search space, working principle. Encoding : binary, Octal, Hexadecimal, permutation, Value and Tree. Decoding, fitness function, Selection : Roulette-wheel, Boltzmann, Tournament, Rank and Steady-state. Elitism, Crossover : single-pint, two-point, multi-point, uniform, matrix and cross over rate, Mutation : mutation, mutation rate. Variations of GA : Adaptive GA and Real coded GA. ; Ant colony optimization : Ant foraging behaviour, combinatorial optimization, Routing in communication network, traveling sales man problem, graph portioning, nest building. ; Particle swarm Optimization : basic principle, algorithm, flowchart. Variations of PSO : weighted, repulsive, stretched, comprehensive learning, combined effect PSO and clonal PSO. ; Bacterial Foraging Optimization : Forging theory, social foraging, foraging behaviour of E. coli bacteria, BFO algorithm, chemotatic, swarming , reproduction and elimination and dispersal. Variations of BFO : fuzzy BFO and Adaptive BFO. ; Artificial Immune System : overview, central and peripheral immune systems, immune network : clonal selection and its mathematical modeling, beyond clonal selection, danger theory, negative selection. ; Applications : function optimization, adaptive system identification, channel equalization and financial forecasting.

Essential readings

1. D. E. Goldberg, *Genetic Algorithms in search*, Optimization and machine learning, 1989.
2. Eric Bonabeau, M. Dorigo and G. Theraulaz, *Swarm Intelligence : From natural to Artificial Systems*, (Santa Fe Institute Studies in the Sciences of Complexity Proceedings), 1999.

Suggested Readings

1. R.C. Eberhart, Y. Sai and J. Kennedy, *Swarm Intelligence , The Morgan Kaufmann Series in artificial Intelligence,* 2001.
2. K. M. Passino, *Biomimicry for optimization,* control and automation, 2004.
3. D. Dasgupta, *Artificial Immune Systems and their applications*, 1998.
4. Lecturer Notes

EC 471 OPTICAL COMMUNICATION LAB 2 credit [0-0-3]

1. End preparation of optical fiber. Core and cladding diameter measurement of Optical fiber.
2. Investigate the propagation of light through an optical fiber. Calculate the light attenuation due to:
    - Scattering and absorption.
    - Fiber misalignments
    - Numerical aperture mismatch.
    - Core area mismatch.
3. To familiarize with the optical fiber Bi-directional couplers and wavelength division Mux-demux components and the measurements of its different parameters.
4. Experimental studies on LED characteristics.
5. Experimental studies on Photo detector characteristics.
6. Experiment of coupling method between optical fiber and light source.
7. Studies on Fiber-optic communication link design.
8. Studies on adjustable optical attenuator and parameter measurement.
9. Studies of microbend effect on signal propagation through an optical fiber.
10. Fiber characterisation using OTDR.

EC 472 DIGITAL IMAGE PROCESSING LAB 2 credit [0-0-3]

1. Read, Load and Display some color and gray scale images
2. Perform Negative, Logarithmic and Power Law Transformation of different images
3. Find the histogram of the image. Develop histogram-equalization algorithm and display the histogram equalized image
4. Write the programs to perform filtering operation in spatial domain on noisy image corrupted with (i) Gaussian noise (ii) Salt and Pepper noise
5. Find Peak Signal to Noise Ratio (PSNR) in both cases
6. Write program for Ideal Low Pass, Butterworth Low Pass and Gaussian Low Pass filter in frequency domain for removing Gaussian noise from images
7. Write programs for Ideal High Pass, Butterworth High Pass and Gaussian High Pass filter in frequency domain for sharpening different test images
8. Develop compressed image using (i) Run Length Encoding (ii) Huffman Coding
9. Display compressed image. Find the compression ratio and bits/pixel
10. Perform segmentation on bi-level images using Histogram method
11. Segment an image using (i) Region Growing (ii) Region Merging (iii) Region Splitting
12. Write program for Erosion and Dilation
13. Perform the following Geometric Transformations on different images (i) Scaling (ii)Translation (iii) Shearing
14. Mini Project

EC 473 VHDL-LAB 2 credit [0-0-3]

1. Design a full adder using Dataflow modeling.
2. Design a full adder using half-adder.
3. Design a half adder.
4. Design a 4-bit adder cum sub tractor using:
   (a) 4:1 MUX using the following: (a)dataflow (b)using when else (c) structural modeling using 2:1 MUX (d) behavioral modeling using (i)case statement (ii) if else statement (e)mixed style of modeling(use structural, behavioral, dataflow)
5. Design a Decoder(3 : 8) and Encoder (Gray to Binary)

6. Design a BCD to 7-Segment Decoder.
7. Interface the 2-bit adder with 7-segment display.
8. Design 4-bit Even/Odd parity checker & generator.
   (a) Design of Flip-Flops: (a)S-R Flip Flop (b)J-K Flip Flop (c) D Flip Flop (d) T Flip Flop
9. Design of counters:
   - 4 bit up counter(use asynchronous reset) (b)4 bit down counter(use synchronous reset) (c) 4-bit up/down counter (d)Decade counter.
   - Design of Shift-Register: (a)Serial-in serial-out (b)Serial-in parallel-out.
   - Design the following using Generic (a)Generic Decoder (b)Generic parity (c) detector.
   - Generic parity generator.
10. Microcomputer programming. design programs for microcontrollers in assembly language, with the use of different addressing modes, subroutines and stack operations, and interrupts.

    Examples:
    - Hexadecimal addition of two numbers.
    - Splitting a byte into nibbles.
    - Hexadecimal multiplication of two numbers.
    - Display letter 'A' on dot matrix display.
    - Check the number for being odd or even.

EC 474 DSP PROCESSOR LAB 2 credit [0-0-3]

1. Familiarization with Texas instruments based DSP processors.
2. Familiarization with Analog Devices based DSP processors
3. Practice on processors language
4. Implementation of various transforms and their inverses : DFT, FFT, DCT, DHT and DWT.
5. Implementation of circular convolution and correlation in time and DFT domains.
6. Implementation of overlap-save based linear convolution in time and DFT domains
7. Implementation of low pass and high pass FIR filter using windowing technique
8. Implementation of bilinear transformation based IIR filter
9. System Identification using LMS based tap-delay adaptive filter
10. Channel equalization of linear and nonlinear channels using LMS technique
11. Recovery of fundamental frequency from a mixture of signal and noise

EC 475 VLSI-LAB 2 credit [0-0-3]

1. Study of PMOS & NMOS Characteristics using SPICE
2. Layout of Basic circuit elements NMOS, PMOS using L-Edit
3. Layout & Circuit Simulation of CMOS Inverter
4. Study the static behavior of CMOS inverter w.r.t. V_{DD} and Temperature
5. Study the Dynamic behavior of CMOS inverter w.r.t. $V_{DD,}$
6. Simulation of basic gates.
7. Simulation of Combinational and Sequential circuits
8. Layout experiments of devices and inverter
9. Layout of Combinational Circuits
10. Layout of Sequential Circuits

EC 476 BIOMEDICAL LABORATORY 2 credit [0-0-3]

1. Study and recording of Electrocardiograph.
2. Study and recording of Electroencephalograph.
3. Study and recording of Electromyograph.

4. Design of pulse sensor.
5. Design of respiration sensor.
6. Blood pH measurement
7. Measurement of blood pCO_2
8. Study on photoplethysmography and its use for heart beat counting.

EC 477 MOBILE COMMUICATION LAB 2 credit [0-0-3]

1. Generation of baseband signal for GSM, CDMA, Bluetooth, WLAN and WiMAX. Estimation of the signal spectrum at baseband.
2. Analyze the working of the RF section of a mobile cellular receiver.
3. Signal generation, reception and analysis of Bluetooth signal using random number as information bits.
4. Simulate the working of codec in a GSM receiver using MATLAB and Labview.
5. Analyze propagation characteristics of GSM, IS95, CDMA2000 using Qualnet simulator.
6. Determine the mobile channel transfer function using vector network analyzer, signal generator and spectrum analyzer.
7. Test an error correction coding scheme using software defined radio system.
8. Design equalizer for GSM receiver on a software defined radio system.
9. Design a mobile CDMA receiver using software defined radio set.

EC 479 PROCESS CONTROL LABORATORY 2 credits [0-0-3]

1 To study the characteristics of P/I & I/P converter.
2 Determination of the different types of valve characteristics & calculate the gain at various condition.
3 Study and synthesis of Hydraulic & Pneumatic systems using Trainers.
4 Experiments on Air velocity sensor and its associate signal conditioner circuit.
5 Performance analysis on ON-OFF/P/PI/PD/PID controllers on Co-Current and Counter Current Heat Exchanger Process.
6 Phase- Plane analysis on Relay Control system.
7 Study of Linear System Simulator.
8 Study of Compensation Design Network.