

**COMSATS Institute of Information Technology
Registrar Office, Principal Seat, Islamabad**

No: CIIT-Reg/Notif- 105 /12/150

January 25, 2012

Notification

It is hereby notified that the Board of Advanced Studies and Research in its 13th meeting held on September 26, 2011, approved the following Scheme of Studies of Master of Science in Electrical Engineering effective from Fall 2010 and onwards admissions at CIIT System:

	<u>No. of Courses</u>	<u>Credit Hours</u>
1. MS Course Work		
1) Core Courses (List attached)	1-4	03-12
2) Specialization/Area Elective Courses (List attached)	3-6	9-18
3) Open/Cross Area Elective Course	1-4	3-12
Total Credit Hours of course work	08	24
2. MS Thesis/MS Project/ Additional courses in lieu of Thesis**		06
3. Total Credit Hours of the Program		30
4. Graduate Regulations*		
a) Minimum duration for completion of the program is 1 ½ years.		
b) Graduate Rules and Regulations shall be applicable		

This issues with the approval of the Competent Authority and supersedes Notifications No. CIIT/DGS-11/3348/10 dated January 01, 2011 and CIIT-Reg/Notif-558/11/1331 dated September 19, 2011.


Muhammad Hanif
Deputy Registrar

Encl: (Pages 66 including this page)

Distribution:

1. Dean, Faculty of Engineering, CIIT
2. Dean of Research, Innovation and Commercialization (DORIC), CIIT
3. All Directors CIIT System.
4. Chairman, Department of Electrical Engineering, CIIT
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6. All HoD's/Incharges, Department of Electrical Engineering, CIIT Campuses
7. Controller of Examinations, CIIT
8. All Incharges, Examination Departments, CIIT Campuses.
9. GM(IT), CIIT Islamabad Campus for uploading on Web under "Graduate Handbook" Portal.
10. AR(Exams) for coordination with GM(IT).

CC:

1. Registrar, CIIT
2. PS to Rector

* Graduate Regulations (a&b) amended by BASAR from time to time shall be applicable.

** In light of the Notification No. CIIT-Reg/Notif-89/12/116 dated January 18, 2012, the courses in lieu of thesis in the above program shall not be offered from Fall 2012.

List of Core Courses;

Sr.No.	Course Code	Course Title	Credit Hours
1.	EEE610	Engineering Mathematics	3(3, 0)
2.	ECI610*	Advanced Digital Design	3(3, 0)
3.	ECI614*	Advanced Computer Architecture	3(3, 0)
4.	ECI665*	Linear Systems Theory	3(3, 0)
5.	EEE611	Stochastic Processes	3(3, 0)
6.	EEP620*	Integrated Circuit Analysis and Design	3(3, 0)
7.	EPE621*	Advanced Power System Protection	3(3, 0)
8.	EPE625*	Advanced Power System Analysis	3(3, 0)
9.	EPE626*	Advanced Power System Operation and Control	3(3, 0)
10.	ETN630*	Radar Systems	3(3, 0)
11.	ETN640*	Communication Systems Engineering	3(3, 0)
12.	ETN641*	Digital Communications	3(3, 0)
13.	ETN670*	Communication Networks-Architectures and Protocols	3(3, 0)
14.	ETN671*	Data Networks and Communications	3(3, 0)

* These courses can also fulfill Area Electives requirements of a particular specialization.

1. List of Area Electives Courses with specializations;

(i) Computer Engineering

Sr.No.	Course Code	Course Title	Credit Hours
1.	ECI610	Advanced Digital Design	3(3, 0)
2.	ECI611	Logic Design and Switching Theory	3(3, 0)
3.	ECI612	Advanced Microprocessor Systems	3(3, 0)
4.	ECI613	Advanced Operating Systems	3(3, 0)
5.	ECI614	Advanced Computer Architecture	3(3, 0)
6.	ECI620	ASIC and FPGA Design	3(3, 0)
7.	ECI621	DSP Hardware Systems Design	3(3, 0)
8.	ECI622	DSP Software Systems Design	3(3, 0)
9.	ECI623	VLSI System Design	3(3, 0)
10.	ECI624	Microprocessor/Microcontroller Based Systems	3(3, 0)
11.	ECI630	Mobile Devices Programming	3(3, 0)
12.	ECI631	Web Technologies	3(3, 0)
13.	ECI632	Advanced Programming Techniques	3(3, 0)
14.	ECI633	Software Development Methodologies	3(3, 0)
15.	ECI634	Distributed Databases	3(3, 0)
16.	ECI635	Object Oriented Databases	3(3, 0)
17.	ECI636	Web Based Databases	3(3, 0)
18.	ECI637	Data Structures for Computer Graphics	3(3, 0)
19.	ECI640	Advanced Digital Signal Processing	3(3, 0)
20.	ECI641	Digital Image Processing	3(3, 0)
21.	ECI642	Digital Filters	3(3, 0)
22.	ECI650	Image, Video, and Multimedia	3(3, 0)
23.	ECI651	Multimedia Indexing and Retrieval	3(3, 0)
24.	ECI652	Multimedia Technologies	3(3, 0)
25.	ECI653	Fundamentals of Computer Graphics	3(3, 0)
26.	ECI660	Linear Control Systems	3(3, 0)
27.	ECI661	Digital Control Systems	3(3, 0)
28.	ECI662	Optimization Control Theory	3(3, 0)
29.	ECI663	Robotics	3(3, 0)
30.	ECI664	Industrial Automation and Control	3(3, 0)
31.	ECI670	Neural and Fuzzy Systems	3(3, 0)
32.	ECI671	Artificial Intelligence	3(3, 0)
33.	ECI672	Natural Language Processing	3(3, 0)
34.	ECI673	Automata Theory	3(3, 0)
35.	ECI674	Pattern Recognition	3(3, 0)
36.	ECI710	Computer-Aided Design of Digital Systems I	3(3, 0)
37.	ECI711	Performance of Computer Systems	3(3, 0)

38.	ECI712	Multithreaded Architectures	3(3, 0)
39.	ECI713	Parallel Processing	3(3, 0)
40.	ECI714	Diagnosis and Design of Reliable Digital Systems	3(3, 0)
41.	ECI715	Real Time Computer Systems	3(3, 0)
42.	ECI716	Probabilistic Methods in Computer Systems Modeling	3(3, 0)
43.	ECI717	Compiler Design	3(3, 0)
44.	ECI718	Analysis of Algorithms	3(3, 0)
45.	ECI720	Hardware/Software Co-Design Techniques	3(3, 0)
46.	ECI721	Embedded Software and RTOS	3(3, 0)
47.	ECI722	Mixed-Signal VLSI Systems Design	3(3, 0)
48.	ECI723	Embedded Computing Systems	3(3, 0)
49.	ECI724	VLSI Architectures and Algorithms	3(3, 0)
50.	ECI725	Design of Systems on a Chip (SoC)	3(3, 0)
51.	ECI726	Design of Real-Time Embedded Systems	3(3, 0)
52.	ECI730	Protocol Software Design and Development	3(3, 0)
53.	ECI731	Data Warehousing	3(3, 0)
54.	ECI732	Data Mining	3(3, 0)
55.	ECI733	Requirements Engineering	3(3, 0)
56.	ECI734	Software Project Management	3(3, 0)
57.	ECI735	Software Quality Assurance	3(3, 0)
58.	ECI736	Software Engineering Technologies	3(3, 0)
59.	ECI737	Object Oriented Software Engineering	3(3, 0)
60.	ECI738	Geometric Modeling	3(3, 0)
61.	ECI739	Computer Animation	3(3, 0)
62.	ECI740	Estimation of Signals and Systems	3(3, 0)
63.	ECI741	Audio Signal Processing	3(3, 0)
64.	ECI742	Adaptive Signal Processing	3(3, 0)
65.	ECI743	Computer Vision	3(3, 0)
66.	ECI744	Advanced Pattern Recognition	3(3, 0)
67.	ECI745	3-D and Virtual Imaging	3(3, 0)
68.	ECI746	Detection and Estimation Theory	3(3, 0)
69.	ECI747	Advanced Filter Design	3(3, 0)
70.	ECI748	Machine Learning	3(3, 0)
71.	ECI750	Multimedia Data Compression	3(3, 0)
72.	ECI753	Advanced Computer Graphics	3(3, 0)
73.	ECI760	Non-Linear Systems & Control	3(3, 0)
74.	ECI761	Intelligent Control Systems	3(3, 0)
75.	ECI762	Advanced Linear Systems	3(3, 0)
76.	ECI763	Multivariable Control	3(3, 0)
77.	ECI764	Adaptive Control	3(3, 0)
78.	ECI765	Robust Control	3(3, 0)
79.	ECI810	Computer-Aided Design of Digital Systems II	3(3, 0)
80.	ECI811	Special Topics in Computer Systems Architectures	3(3, 0)

81.	ECI812	Advanced Topics in Digital Design	3(3, 0)
82.	ECI813	Advanced Topics in Operating Systems	3(3, 0)
83.	ECI814	Advanced Microprocessor/Microcontroller Systems	3(3, 0)
84.	ECI815	Special Topics in Digital Design	3(3, 0)
85.	ECI820	Advanced Topics in Embedded System Design	3(3, 0)
86.	ECI821	Advanced Topics in VLSI Design	3(3, 0)
87.	ECI822	Advanced Topics in Real-Time Embedded System Design	3(3, 0)
88.	ECI833	Security Applications: Watermarking and Biometrics	3(3, 0)
89.	ECI834	Data Authentication Techniques	3(3, 0)
90.	ECI835	Digital Watermarking	3(3, 0)
91.	ECI839	Advanced Computer Animation	3(3, 0)
92.	ECI840	Special Topics in Signal Processing	3(3, 0)
93.	ECI841	Advanced Topics in Image Processing	3(3, 0)
94.	ECI842	Advanced Topics in Computer Vision	3(3, 0)
95.	ECI847	Advanced Topics in Filter Design	3(3, 0)
96.	ECI850	Advanced Topics in Multimedia Technologies	3(3, 0)
97.	ECI853	Advanced Topics in Computer Graphics	3(3, 0)
98.	ECI860	Advanced Topics in Control Systems	3(3, 0)
99.	ECI870	Advanced Topics in AI and Neural Computing	3(3, 0)
100.	ECI871	Advanced Topics in Pattern Recognition	3(3, 0)
101.	ECI872	Advanced Topics in Knowledge Based Systems	3(3, 0)
102.	ECI873	Advanced Topics in Decision Support Systems	3(3, 0)
103.	ECI874	Advanced Topics in Machine Learning	3(3, 0)

(ii) Power and Energy Engineering

Sr.No.	Course Code	Course Title	Credit Hours
1.	EPE626	Advanced Power System Operation and Control	3(3, 0)
2.	EPE610	Power Generation and Plant Operation	3(3, 0)
3.	EPE611	Power Transmission and Distribution	3(3, 0)
4.	EPE612	DC and Flexible AC Transmission	3(3, 0)
5.	EPE613	Magneto-Hydrodynamic Power Generation	3(3, 0)
6.	EPE620	Advanced Power System Planning	3(3, 0)
7.	EPE621	Advanced Power System Protection	3(3, 0)
8.	EPE622	Power Engineering Project Management	3(3, 0)
9.	EPE623	High Voltage Engineering Design	3(3, 0)
10.	EPE624	Smart Grid System Operation	3(3, 0)
11.	EPE630	Advanced Power Electronics	3(3, 0)
12.	EPE631	Power Electronics Design	3(3, 0)
13.	EPE632	Electronics For Energy Control	3(3, 0)

14.	EPE640	Design of Electrical Machines	3(3, 0)
15.	EPE641	Square Wave AC Machine Design	3(3, 0)
16.	EPE642	Illumination Engineering	3(3, 0)
17.	EPE650	Energy Resources and Technologies	3(3, 0)
18.	EPE651	Power and Energy Economic Policy	3(3, 0)
19.	EPE660	Non-Conventional Energy Systems	3(3, 0)
20.	EPE661	Renewable Energy	3(3, 0)
21.	EPE662	Energy & Environment	3(3, 0)
22.	EPE663	Renewable Energy Technologies	3(3, 0)
23.	EPE664	Photovoltaic System Design	3(3, 0)
24.	EPE665	Solar Power Generation	3(3, 0)
25.	EPE666	Wind Power Generation	3(3, 0)
26.	EPE667	Biomass and Waste Technology	3(3, 0)
27.	EPE710	Hydel Power Generation	3(3, 0)
28.	EPE710	Hydel Power Generation	3(3, 0)
29.	EPE711	Flexible AC transmission	3(3, 0)
30.	EPE712	Integration of Distributed Generation	3(3, 0)
31.	EPE720	Power System Dynamics	3(3, 0)
32.	EPE721	High Voltage Engineering Design	3(3, 0)
33.	EPE722	Power System Reliability	3(3, 0)
34.	EPE723	Power System Stability and Control	3(3, 0)
35.	EPE724	Power System Transients	3(3, 0)
36.	EPE725	Electric Power Quality	3(3, 0)
37.	EPE726	Computer Methods in Power System Analysis	3(3, 0)
38.	EPE727	Advance Digital Relaying	3(3, 0)
39.	EPE728	Power and Energy Management	3(3, 0)
40.	EPE729	Dynamics and Control of Integrated Power System	3(3, 0)
41.	EPE740	AC/DC Drives	3(3, 0)
42.	EPE741	Dynamic Modeling of Electric Machines and Controls	3(3, 0)
43.	EPE750	Sustainable Energy Systems	3(3, 0)
44.	EPE751	Geothermal System Design	3(3, 0)
45.	EPE752	Coal Pyrolysis and Gasification	3(3, 0)
46.	EPE753	Marine Power Engineering	3(3, 0)
47.	EPE754	Hybrid Power Systems	3(3, 0)
48.	ERE755	Combined Cycle Power and Energy Systems	3(3, 0)
49.	EPE760	Carbon Capture and Storage	3(3, 0)
50.	EPE761	Hydrogen and Fuel Cell Technology	3(3, 0)
51.	EPE762	Energy and Storage System	3(3, 0)
52.	EPE820	Advanced Topics in Power Systems Engineering	3(3, 0)
53.	EPE821	Optimization and Economics of Integrated Power Systems	3(3, 0)
54.	EPE860	Advanced Topics in Renewable Energy	3(3, 0)

(iii) Electronic Systems Engineering

Sr.No.	Course Code	Course Title	Credit Hours
1.	EEP610	Fundamentals of Semiconductor Devices	3(3, 0)
2.	EEP611	Circuit Modeling of Solid-State Devices	3(3, 0)
3.	EEP612	Active Semiconductor Devices	3(3, 0)
4.	EEP613	Solid State Electronic Devices	3(3, 0)
5.	EEP620	Integrated Circuit Analysis and Design	3(3, 0)
6.	EEP630	Theory of Optical Fibers	3(3, 0)
7.	EEP631	Optical Fiber Devices and Components	3(3, 0)
8.	EEP632	Semiconductor Optoelectronic Devices	3(3, 0)
9.	EEP634	Laser and Modern Optics	3(3, 0)
10.	EEP640	Lasers and Optical Communication	3(3, 0)
11.	EEP641	Optical Communications	3(3, 0)
12.	EEP642	Optical Signal Processing	3(3, 0)
13.	EEP650	Introduction to MEMS	3(3, 0)
14.	EEP651	Nanosystems	3(3, 0)
15.	EEP652	Introduction to Nanoscience and Technology	3(3, 0)
16.	EEP710	MOS VLSI Circuit Design	3(3, 0)
17.	EEP711	Quantum Physical Electronics	3(3, 0)
18.	EEP712	Electronic Materials	3(3, 0)
19.	EEP713	Semiconductor Processing Technology	3(3, 0)
20.	EEP714	Advanced Semiconductor Materials	3(3, 0)
21.	EEP715	Semiconductor Power Devices	3(3, 0)
22.	EEP730	Principles of Fiber and Integrated Optics	3(3, 0)
23.	EEP731	Integrated Optical Circuits and Devices	3(3, 0)
24.	EEP732	Optical Sensors	3(3, 0)
25.	EEP740	Optical Fiber Components and Transmission Systems	3(3, 0)
26.	EEP741	Optical Fiber Communication Systems	3(3, 0)
27.	EEP742	High Speed Photonic Components	3(3, 0)
28.	EEP810	Low Power Analog and Mixed Signal ICs	3(3, 0)
29.	EEP811	Advanced Topics in Integrated Circuit Design	3(3, 0)
30.	EEP812	Special Topics in Microelectronics	3(3, 0)
31.	EEP813	Advanced Topics in Solid State Devices	3(3, 0)
32.	EEP830	Advanced Optoelectronic and Photonic Devices	3(3, 0)
33.	EEP831	Advanced Topics in Optical System and Devices	3(3, 0)
34.	EEP840	Optical Networks - Transport and Switching	3(3, 0)
35.	EEP841	Next Generation Optical Networks	3(3, 0)
36.	EEP842	Advanced Topics in Optical Networks	3(3, 0)
37.	EEP843	Advanced Topics in Optical Communications	3(3, 0)
38.	EEP850	Advanced Topics in Micro Systems Fabrication	3(3, 0)
39.	ECI610	Advanced Digital Design	3(3, 0)

40.	ECI611	Logic Design and Switching Theory	3(3, 0)
41.	ECI612	Advanced Microprocessor Systems	3(3, 0)
42.	ECI613	Advanced Operating Systems	3(3, 0)
43.	ECI620	ASIC and FPGA Design	3(3, 0)
44.	ECI621	DSP Hardware Systems Design	3(3, 0)
45.	ECI622	DSP Software Systems Design	3(3, 0)
46.	ECI623	VLSI System Design	3(3, 0)
47.	ECI624	Microprocessor/Microcontroller Based Systems	3(3, 0)
48.	ECI630	Mobile Devices Programming	3(3, 0)
49.	ECI640	Advanced Digital Signal Processing	3(3, 0)
50.	ECI641	Digital Image Processing	3(3, 0)
51.	ECI642	Digital Filters	3(3, 0)
52.	ECI650	Image, Video, and Multimedia	3(3, 0)
53.	ECI651	Multimedia Indexing and Retrieval	3(3, 0)
54.	ECI652	Multimedia Technologies	3(3, 0)
55.	ECI653	Fundamentals of Computer Graphics	3(3, 0)
56.	ECI660	Linear Control Systems	3(3, 0)
57.	ECI661	Digital Control Systems	3(3, 0)
58.	ECI662	Optimization Control Theory	3(3, 0)
59.	ECI663	Robotics	3(3, 0)
60.	ECI664	Industrial Automation and Control	3(3, 0)
61.	ECI710	Computer-Aided Design of Digital Systems I	3(3, 0)
62.	ECI711	Performance of Computer Systems	3(3, 0)
63.	ECI712	Multithreaded Architectures	3(3, 0)
64.	ECI713	Parallel Processing	3(3, 0)
65.	ECI714	Diagnosis and Design of Reliable Digital Systems	3(3, 0)
66.	ECI715	Real Time Computer Systems	3(3, 0)
67.	ECI716	Probabilistic Methods in Computer Systems Modeling	3(3, 0)
68.	ECI720	Hardware/Software Co-Design Techniques	3(3, 0)
69.	ECI721	Embedded Software and RTOS	3(3, 0)
70.	ECI722	Mixed-Signal VLSI Systems Design	3(3, 0)
71.	ECI723	Embedded Computing Systems	3(3, 0)
72.	ECI724	VLSI Architectures and Algorithms	3(3, 0)
73.	ECI725	Design of Systems on a Chip (SoC)	3(3, 0)
74.	ECI726	Design of Real-Time Embedded Systems	3(3, 0)
75.	ECI730	Protocol Software Design and Development	3(3, 0)
76.	ECI740	Estimation of Signals and Systems	3(3, 0)
77.	ECI741	Audio Signal Processing	3(3, 0)
78.	ECI742	Adaptive Signal Processing	3(3, 0)
79.	ECI743	Computer Vision	3(3, 0)
80.	ECI744	Advanced Pattern Recognition	3(3, 0)
81.	ECI745	3-D and Virtual Imaging	3(3, 0)
82.	ECI746	Detection and Estimation Theory	3(3, 0)

83.	ECI747	Advanced Filter Design	3(3, 0)
84.	ECI748	Machine Learning	3(3, 0)
85.	ECI750	Multimedia Data Compression	3(3, 0)
86.	ECI753	Advanced Computer Graphics	3(3, 0)
87.	ECI760	Non-Linear Systems & Control	3(3, 0)
88.	ECI761	Intelligent Control Systems	3(3, 0)
89.	ECI762	Advanced Linear Systems	3(3, 0)
90.	ECI763	Multivariable Control	3(3, 0)
91.	ECI764	Adaptive Control	3(3, 0)
92.	ECI765	Robust Control	3(3, 0)
93.	ECI810	Computer-Aided Design of Digital Systems II	3(3, 0)
94.	ECI811	Special Topics in Computer Systems Architectures	3(3, 0)
95.	ECI812	Advanced Topics in Digital Design	3(3, 0)
96.	ECI813	Advanced Topics in Operating Systems	3(3, 0)
97.	ECI814	Advanced Microprocessor/Microcontroller Systems	3(3, 0)
98.	ECI815	Special Topics in Digital Design	3(3, 0)
99.	ECI820	Advanced Topics in Embedded System Design	3(3, 0)
100.	ECI821	Advanced Topics in VLSI Design	3(3, 0)
101.	ECI822	Advanced Topics in Real-Time Embedded System Design	3(3, 0)
102.	ECI833	Security Applications: Watermarking and Biometrics	3(3, 0)
103.	ECI834	Data Authentication Techniques	3(3, 0)
104.	ECI835	Digital Watermarking	3(3, 0)
105.	ECI839	Advanced Computer Animation	3(3, 0)
106.	ECI840	Special Topics in Signal Processing	3(3, 0)
107.	ECI841	Advanced Topics in Image Processing	3(3, 0)
108.	ECI842	Advanced Topics in Computer Vision	3(3, 0)
109.	ECI847	Advanced Topics in Filter Design	3(3, 0)
110.	ECI850	Advanced Topics in Multimedia Technologies	3(3, 0)
111.	ECI853	Advanced Topics in Computer Graphics	3(3, 0)
112.	ECI860	Advanced Topics in Control Systems	3(3, 0)
113.	ECI870	Advanced Topics in AI and Neural Computing	3(3, 0)
114.	ECI871	Advanced Topics in Pattern Recognition	3(3, 0)
115.	ECI872	Advanced Topics in Knowledge Based Systems	3(3, 0)
116.	ECI873	Advanced Topics in Decision Support Systems	3(3, 0)
117.	ECI874	Advanced Topics in Machine Learning	3(3, 0)

(iv) Photonic Systems Engineering

Sr.No.	Course Code	Course Title	Credit Hours
1.	EEP610	Fundamentals of Semiconductor Devices	3(3, 0)
2.	EEP611	Circuit Modeling of Solid-State Devices	3(3, 0)

3.	EEP612	Active Semiconductor Devices	3(3, 0)
4.	EEP613	Solid State Electronic Devices	3(3, 0)
5.	EEP620	Integrated Circuit Analysis and Design	3(3, 0)
6.	EEP630	Theory of Optical Fibers	3(3, 0)
7.	EEP631	Optical Fiber Devices and Components	3(3, 0)
8.	EEP632	Semiconductor Optoelectronic Devices	3(3, 0)
9.	EEP634	Laser and Modern Optics	3(3, 0)
10.	EEP640	Lasers and Optical Communication	3(3, 0)
11.	EEP641	Optical Communications	3(3, 0)
12.	EEP642	Optical Signal Processing	3(3, 0)
13.	EEP650	Introduction to MEMS	3(3, 0)
14.	EEP651	Nanosystems	3(3, 0)
15.	EEP652	Introduction to Nanoscience and Technology	3(3, 0)
16.	EEP710	MOS VLSI Circuit Design	3(3, 0)
17.	EEP711	Quantum Physical Electronics	3(3, 0)
18.	EEP712	Electronic Materials	3(3, 0)
19.	EEP713	Semiconductor Processing Technology	3(3, 0)
20.	EEP714	Advanced Semiconductor Materials	3(3, 0)
21.	EEP715	Semiconductor Power Devices	3(3, 0)
22.	EEP730	Principles of Fiber and Integrated Optics	3(3, 0)
23.	EEP731	Integrated Optical Circuits and Devices	3(3, 0)
24.	EEP732	Optical Sensors	3(3, 0)
25.	EEP740	Optical Fiber Components and Transmission Systems	3(3, 0)
26.	EEP741	Optical Fiber Communication Systems	3(3, 0)
27.	EEP742	High Speed Photonic Components	3(3, 0)
28.	EEP810	Low Power Analog and Mixed Signal ICs	3(3, 0)
29.	EEP811	Advanced Topics in Integrated Circuit Design	3(3, 0)
30.	EEP812	Special Topics in Microelectronics	3(3, 0)
31.	EEP813	Advanced Topics in Solid State Devices	3(3, 0)
32.	EEP830	Advanced Optoelectronic and Photonic Devices	3(3, 0)
33.	EEP831	Advanced Topics in Optical System and Devices	3(3, 0)
34.	EEP840	Optical Networks - Transport and Switching	3(3, 0)
35.	EEP841	Next Generation Optical Networks	3(3, 0)
36.	EEP842	Advanced Topics in Optical Networks	3(3, 0)
37.	EEP843	Advanced Topics in Optical Communications	3(3, 0)
38.	EEP850	Advanced Topics in Micro Systems Fabrication	3(3, 0)

(v) Automation and Control Engineering

Sr.No	Course Code	Course Title	Credit Hours
01	ECI624	Microprocessor/Microcontroller Based Systems	3(3, 0)
02	ECI640	Advanced Digital Signal Processing	3(3, 0)

03	ECI641	Digital Image Processing	3(3, 0)
04	ECI642	Digital Filters	3(3, 0)
05	ECI650	Image, Video, and Multimedia	3(3, 0)
06	ECI653	Fundamentals of Computer Graphics	3(3, 0)
07	ECI660	Linear Control Systems	3(3, 0)
08	ECI661	Digital Control Systems	3(3, 0)
09	ECI662	Optimization Control Theory	3(3, 0)
10	ECI663	Robotics	3(3, 0)
11	ECI664	Industrial Automation and Control	3(3, 0)
51	ECI665	Linear Systems Theory	3(3, 0)
12	ECI670	Neural and Fuzzy Systems	3(3, 0)
13	ECI671	Artificial Intelligence	3(3, 0)
14	ECI673	Automata Theory	3(3, 0)
15	ECI674	Pattern Recognition	3(3, 0)
16	ECI715	Real Time Computer Systems	3(3, 0)
17	ECI718	Analysis of Algorithms	3(3, 0)
18	ECI723	Embedded Computing Systems	3(3, 0)
19	ECI726	Design of Real-Time Embedded Systems	3(3, 0)
20	ECI738	Geometric Modeling	3(3, 0)
21	ECI740	Estimation of Signals and Systems	3(3, 0)
22	ECI741	Audio Signal Processing	3(3, 0)
23	ECI742	Adaptive Signal Processing	3(3, 0)
24	ECI743	Computer Vision	3(3, 0)
25	ECI744	Advanced Pattern Recognition	3(3, 0)
26	ECI746	Detection and Estimation Theory	3(3, 0)
27	ECI747	Advanced Filter Design	3(3, 0)
28	ECI748	Machine Learning	3(3, 0)
29	ECI750	Multimedia Data Compression	3(3, 0)
30	ECI753	Advanced Computer Graphics	3(3, 0)
31	ECI760	Non-Linear Systems & Control	3(3, 0)
32	ECI761	Intelligent Control Systems	3(3, 0)
33	ECI762	Advanced Linear Systems	3(3, 0)
34	ECI763	Multivariable Control	3(3, 0)
35	ECI764	Adaptive Control	3(3, 0)
36	ECI765	Robust Control	3(3, 0)
37	ECI770	Intelligent Systems	3(3, 0)
38	ECI814	Advanced Microprocessor/Microcontroller Systems	3(3, 0)
39	ECI820	Advanced Topics in Embedded System Design	3(3, 0)
		Advanced Topics in Real-Time Embedded System Design	
40	ECI822	Design	3(3, 0)
41	ECI840	Special Topics in Signal Processing	3(3, 0)
42	ECI841	Advanced Topics in Image Processing	3(3, 0)
43	ECI842	Advanced Topics in Computer Vision	3(3, 0)

44	ECI847	Advanced Topics in Filter Design	3(3, 0)
45	ECI850	Advanced Topics in Multimedia Technologies	3(3, 0)
46	ECI853	Advanced Topics in Computer Graphics	3(3, 0)
47	ECI860	Advanced Topics in Control Systems	3(3, 0)
48	ECI870	Advanced Topics in AI and Neural Computing	3(3, 0)
49	ECI871	Advanced Topics in Pattern Recognition	3(3, 0)
50	ECI874	Advanced Topics in Machine Learning	3(3, 0)

(vi) Telecommunications Engineering

Sr.No.	Course Code	Course Title	Credit Hours
1.	ETN610	Electromagnetic Field Theory	3(3, 0)
2.	ETN611	Microwave Passive Devices and Circuits	3(3, 0)
3.	ETN612	Microwave Active Devices and Circuits	3(3, 0)
4.	ETN613	Introduction to RF Front-End Design	3(3, 0)
5.	ETN614	RF System Engineering and Design	3(3, 0)
6.	ETN615	RF Filter Design	3(3, 0)
7.	ETN616	Radio Engineering	3(3, 0)
8.	ETN620	Antennas Theory, Design and Applications	3(3, 0)
9.	ETN621	Radio Wave Propagation	3(3, 0)
10.	ETN622	RF Propagation and Planning for Wireless Communications	3(3, 0)
11.	ETN630	Radar Systems	3(3, 0)
12.	ETN631	Satellite Communications	3(3, 0)
13.	ETN632	GPS and Navigation Systems	3(3, 0)
14.	ETN640	Communication Systems Engineering	3(3, 0)
15.	ETN641	Digital Communications	3(3, 0)
16.	ETN642	Information Theory and Coding	3(3, 0)
17.	ETN643	Communication Signal Processing	3(3, 0)
18.	ETN644	Wireless Communication Techniques	3(3, 0)
19.	ETN650	Communication Electronics Design	3(3, 0)
20.	ETN651	Embedded System Design for Telecommunications	3(3, 0)
21.	ETN660	Digital Telephony	3(3, 0)
22.	ETN661	Telecommunication Switching Systems	3(3, 0)
23.	ETN662	Performance Analysis of Communication Systems	3(3, 0)
24.	ETN663	Telecommunication Network Management	3(3, 0)
25.	ETN664	Optical Fiber Networks	3(3, 0)
26.	ETN665	Communication System Design	3(3, 0)
27.	ETN670	Communication Networks-Architectures and Protocols	3(3, 0)
28.	ETN671	Data Networks and Communications	3(3, 0)
29.	ETN672	Queuing Theory for Performance Modeling	3(3, 0)

30.	ETN673	Graph Theory and Network Optimization	3(3, 0)
31.	ETN674	Network Management and Operational Network Security	3(3, 0)
32.	ETN675	Internet Architectures and Protocols	3(3, 0)
33.	ETN676	Internetworking: Architectures, Protocols and Applications	3(3, 0)
34.	ETN677	Internet Applications and Services	3(3, 0)
35.	ETN678	Design of Computer Communication Networks	3(3, 0)
36.	ETN679	Interconnection Networks	3(3, 0)
37.	ETN680	Wireless Networks	3(3, 0)
38.	ETN681	Mobile Cellular Systems and Standards	3(3, 0)
39.	ETN682	Mobile and Broadband Networks	3(3, 0)
40.	ETN683	Wireless LANs	3(3, 0)
41.	ETN684	Mobile Applications and Services	3(3, 0)
42.	ETN685	Mobile Communication Systems	3(3, 0)
43.	ETN686	Wireless Sensor Networks	3(3, 0)
44.	ETN710	Electromagnetic Interference and Compatibility	3(3, 0)
		Numerical and Computational Techniques in	
45.	ETN711	Electromagnetics	3(3, 0)
46.	ETN712	Microwave Integrated Circuits	3(3, 0)
47.	ETN713	RF and Microwave Measurement Techniques	3(3, 0)
48.	ETN720	Smart Antennas for Mobile Communications	3(3, 0)
49.	ETN730	Radar Signal Processing	3(3, 0)
50.	ETN731	Modern Radar Systems	3(3, 0)
51.	ETN740	Advanced Communication Systems Engineering	3(3, 0)
52.	ETN741	Advanced Digital Communications	3(3, 0)
53.	ETN742	Advanced Information Theory and Coding	3(3, 0)
54.	ETN743	Adaptive Techniques for Wireless Communications	3(3, 0)
55.	ETN744	Advanced Wireless Communications	3(3, 0)
56.	ETN745	Advanced Channel Coding Techniques	3(3, 0)
57.	ETN746	Channel Estimation and Characterization	3(3, 0)
58.	ETN747	Communication Channel Modeling	3(3, 0)
59.	ETN748	Wireless Channel Modeling	3(3, 0)
60.	ETN750	Advanced Integrated Circuits for Communication	3(3, 0)
61.	ETN760	Teletraffic Engineering	3(3, 0)
62.	ETN761	Broadband Network Architectures	3(3, 0)
63.	ETN762	Broadband Access Networks	3(3, 0)
64.	ETN763	Telecommunication Software Design	3(3, 0)
65.	ETN764	Modeling and Analysis of Telecommunication Networks	3(3, 0)
66.	ETN765	Transport and Switching Technologies	3(3, 0)
67.	ETN766	Short-Range Communication Systems	3(3, 0)
68.	ETN767	Mobile Computing	3(3, 0)
69.	ETN770	IP Routing Protocols and Internetwork Design	3(3, 0)
70.	ETN771	Advanced Network Programming	3(3, 0)
71.	ETN772	Networks and Computer Security	3(3, 0)

72.	ETN773	Performance Evaluation of Computer Networks	3(3, 0)
73.	ETN774	Cryptography and Secure Communication	3(3, 0)
74.	ETN775	IP Telephony	3(3, 0)
75.	ETN776	Design and Analysis of Computer Communication Networks	3(3, 0)
76.	ETN777	Multimedia Networking	3(3, 0)
77.	ETN778	Network Programming Techniques	3(3, 0)
78.	ETN779	High-Speed Switched Local Area Networks (LANs)	3(3, 0)
79.	ETN780	RF Network Planning and Design	3(3, 0)
80.	ETN781	Emerging Wireless Networks	3(3, 0)
81.	ETN782	QoS Architectures for Multimedia Wireless Networks	3(3, 0)
82.	ETN783	Mobile Devices Applications Development	3(3, 0)
83.	ETN784	Mobile Networking	3(3, 0)
84.	ETN785	Wireless Medium Access Techniques	3(3, 0)
85.	ETN786	Wireless Wide Area Networks (WWANs)	3(3, 0)
86.	ETN787	Wireless Metropolitan Area Networks (WMANs)	3(3, 0)
87.	ETN788	Wireless Personal and Body Area Networks (WPANs/WBANs)	3(3, 0)
88.	ETN810	Advanced Topics in RF System Design	3(3, 0)
89.	ETN811	Advanced Topics in RF/Microwave Engineering	3(3, 0)
90.	ETN820	Advanced Topics in Antenna Design	3(3, 0)
91.	ETN821	Advanced Topics in Radio Wave Propagation	3(3, 0)
92.	ETN822	Advanced Topics in RF Planning and Optimization	3(3, 0)
93.	ETN840	Special Topics in Communication Systems	3(3, 0)
94.	ETN841	Advanced Topics in Communications Theory	3(3, 0)
95.	ETN842	Advanced Topics in Communication Signal Processing	3(3, 0)
96.	ETN843	Advanced Topics in Wireless Communications	3(3, 0)
97.	ETN844	Advanced Topics in Information Theory and Coding	3(3, 0)
98.	ETN845	Advanced Topics in Error Control Coding	3(3, 0)
99.	ETN846	Advanced Topics in Information Security	3(3, 0)
100.	ETN850	Advanced Topics in Telecommunication Electronics	3(3, 0)
101.	ETN870	Network Forensics	3(3, 0)
102.	ETN871	Traffic Engineering and QoS in TCP/IP Networks	3(3, 0)
103.	ETN872	Special Topics in Computer Networks	3(3, 0)
104.	ETN873	Advanced Topics in Network Security	3(3, 0)
105.	ETN874	Advanced Network Security	3(3, 0)
106.	ETN875	Advanced Internetworking (TCP/IP) Protocols	3(3, 0)
107.	ETN880	Advanced Multi-user Systems for Wireless Communications	3(3, 0)
108.	ETN881	Advanced Topics in Wireless Networks	3(3, 0)
109.	ETN882	Selected Topics in Wireless Network Security	3(3, 0)
110.	ETN883	Selected Topics in Wireless Networks Design and Planning	3(3, 0)

111.	ETN884	Advanced Mobile Applications	3(3, 0)
112.	ETN885	Advanced Mobile Networking	3(3, 0)

(vii) Networks Engineering

Sr.No	Course Code	Course Title	Credit Hours
01	ETN640	Communication Systems Engineering	3(3, 0)
02	ETN641	Digital Communications	3(3, 0)
03	ETN644	Wireless Communication Techniques	3(3, 0)
04	ETN660	Digital Telephony	3(3, 0)
05	ETN663	Telecommunication Network Management	3(3, 0)
06	ETN664	Optical Fiber Networks	3(3, 0)
07	ETN672	Queuing Theory for Performance Modeling	3(3, 0)
08	ETN673	Graph Theory and Network Optimization	3(3, 0)
09	ETN674	Network Management and Operational Network Security	3(3, 0)
10	ETN675	Internet Architectures and Protocols	3(3, 0)
11	ETN676	Internetworking: Architectures, Protocols and Applications	3(3, 0)
12	ETN677	Internet Applications and Services	3(3, 0)
13	ETN678	Design of Computer Communication Networks	3(3, 0)
14	ETN679	Interconnection Networks	3(3, 0)
15	ETN680	Wireless Networks	3(3, 0)
16	ETN681	Mobile Cellular Systems and Standards	3(3, 0)
17	ETN682	Mobile and Broadband Networks	3(3, 0)
18	ETN683	Wireless LANs	3(3, 0)
19	ETN684	Mobile Applications and Services	3(3, 0)
20	ETN685	Mobile Communication Systems	3(3, 0)
21	ETN686	Wireless Sensor Networks	3(3, 0)
22	ETN760	Teletraffic Engineering	3(3, 0)
23	ETN761	Broadband Network Architectures	3(3, 0)
24	ETN762	Broadband Access Networks	3(3, 0)
25	ETN763	Telecommunication Software Design	3(3, 0)
26	ETN764	Modeling and Analysis of Telecommunication Networks	3(3, 0)
27	ETN765	Transport and Switching Technologies	3(3, 0)
28	ETN766	Short-Range Communication Systems	3(3, 0)
29	ETN767	Mobile Computing	3(3, 0)
30	ETN770	IP Routing Protocols and Internetwork Design	3(3, 0)
31	ETN771	Advanced Network Programming	3(3, 0)
32	ETN772	Networks and Computer Security	3(3, 0)

33	ETN773	Performance Evaluation of Computer Networks	3(3, 0)
34	ETN774	Cryptography and Secure Communication	3(3, 0)
35	ETN775	IP Telephony	3(3, 0)
36	ETN776	Design and Analysis of Computer Communication Networks	3(3, 0)
37	ETN777	Multimedia Networking	3(3, 0)
38	ETN778	Network Programming Techniques	3(3, 0)
39	ETN779	High-Speed Switched Local Area Networks (LANs)	3(3, 0)
40	ETN780	RF Network Planning and Design	3(3, 0)
41	ETN781	Emerging Wireless Networks	3(3, 0)
42	ETN782	QoS Architectures for Multimedia Wireless Networks	3(3, 0)
43	ETN783	Mobile Devices Applications Development	3(3, 0)
44	ETN784	Mobile Networking	3(3, 0)
45	ETN785	Wireless Medium Access Techniques	3(3, 0)
46	ETN786	Wireless Wide Area Networks (WWANs)	3(3, 0)
47	ETN787	Wireless Metropolitan Area Networks (WMANs)	3(3, 0)
48	ETN788	Wireless Personal and Body Area Networks (WPANs/WBANs)	3(3, 0)
49	ETN846	Advanced Topics in Information Security	3(3, 0)
50	ETN870	Network Forensics	3(3, 0)
51	ETN871	Traffic Engineering and QoS in TCP/IP Networks	3(3, 0)
52	ETN872	Special Topics in Computer Networks	3(3, 0)
53	ETN873	Advanced Topics in Network Security	3(3, 0)
54	ETN874	Advanced Network Security	3(3, 0)
55	ETN875	Advanced Internetworking (TCP/IP) Protocols	3(3, 0)
56	ETN881	Advanced Topics in Wireless Networks	3(3, 0)
57	ETN882	Selected Topics in Wireless Network Security	3(3, 0)
58	ETN883	Selected Topics in Wireless Networks Design and Planning	3(3, 0)
59	ETN884	Advanced Mobile Applications	3(3, 0)
60	ETN885	Advanced Mobile Networking	3(3, 0)
61	ETN670	Communication Networks-Architectures and Protocols	3(3, 0)
62	ETN671	Data Networks and Communications	3(3, 0)

(viii) Communication and Radar Technology

Sr.No	Course Code	Course Title	Credit Hours
01	ETN610	Electromagnetic Field Theory	3(3, 0)
02	ETN611	Microwave Passive Devices and Circuits	3(3, 0)

03	ETN612	Microwave Active Devices and Circuits	3(3, 0)
04	ETN613	Introduction to RF Front-End Design	3(3, 0)
05	ETN614	RF System Engineering and Design	3(3, 0)
06	ETN615	RF Filter Design	3(3, 0)
07	ETN616	Radio Engineering	3(3, 0)
08	ETN620	Antennas Theory, Design and Applications	3(3, 0)
09	ETN621	Radio Wave Propagation	3(3, 0)
10	ETN622	RF Propagation and Planning for Wireless Communications	3(3, 0)
70	ETN630	Radar Systems	3(3, 0)
11	ETN631	Satellite Communications	3(3, 0)
12	ETN632	GPS and Navigation Systems	3(3, 0)
13	ETN640	Communication Systems Engineering	3(3, 0)
14	ETN641	Digital Communications	3(3, 0)
15	ETN642	Information Theory and Coding	3(3, 0)
16	ETN643	Communication Signal Processing	3(3, 0)
17	ETN644	Wireless Communication Techniques	3(3, 0)
18	ETN650	Communication Electronics Design	3(3, 0)
19	ETN651	Embedded System Design for Telecommunications	3(3, 0)
20	ETN660	Digital Telephony	3(3, 0)
21	ETN661	Telecommunication Switching Systems	3(3, 0)
22	ETN662	Performance Analysis of Communication Systems	3(3, 0)
23	ETN665	Communication System Design	3(3, 0)
24	ETN670	Communication Networks-Architectures and Protocols	3(3, 0)
25	ETN671	Data Networks and Communications	3(3, 0)
26	ETN672	Queuing Theory for Performance Modeling	3(3, 0)
27	ETN673	Graph Theory and Network Optimization	3(3, 0)
28	ETN674	Network Management and Operational Network Security	3(3, 0)
29	ETN681	Mobile Cellular Systems and Standards	3(3, 0)
30	ETN682	Mobile and Broadband Networks	3(3, 0)
31	ETN685	Mobile Communication Systems	3(3, 0)
32	ETN710	Electromagnetic Interference and Compatibility	3(3, 0)
33	ETN711	Numerical and Computational Techniques in Electromagnetics	3(3, 0)
34	ETN712	Microwave Integrated Circuits	3(3, 0)
35	ETN713	RF and Microwave Measurement Techniques	3(3, 0)
36	ETN720	Smart Antennas for Mobile Communications	3(3, 0)
37	ETN730	Radar Signal Processing	3(3, 0)
38	ETN731	Modern Radar Systems	3(3, 0)
39	ETN740	Advanced Communication Systems Engineering	3(3, 0)

40	ETN741	Advanced Digital Communications	3(3, 0)
41	ETN742	Advanced Information Theory and Coding	3(3, 0)
42	ETN743	Adaptive Techniques for Wireless Communications	3(3, 0)
43	ETN744	Advanced Wireless Communications	3(3, 0)
44	ETN745	Advanced Channel Coding Techniques	3(3, 0)
45	ETN746	Channel Estimation and Characterization	3(3, 0)
46	ETN747	Communication Channel Modeling	3(3, 0)
47	ETN748	Wireless Channel Modeling	3(3, 0)
48	ETN750	Advanced Integrated Circuits for Communication	3(3, 0)
49	ETN760	Teletraffic Engineering	3(3, 0)
50	ETN764	Modeling and Analysis of Telecommunication Networks	3(3, 0)
51	ETN765	Transport and Switching Technologies	3(3, 0)
52	ETN766	Short-Range Communication Systems	3(3, 0)
53	ETN774	Cryptography and Secure Communication	3(3, 0)
54	ETN780	RF Network Planning and Design	3(3, 0)
55	ETN781	Emerging Wireless Networks	3(3, 0)
56	ETN810	Advanced Topics in RF System Design	3(3, 0)
57	ETN811	Advanced Topics in RF/Microwave Engineering	3(3, 0)
58	ETN820	Advanced Topics in Antenna Design	3(3, 0)
59	ETN821	Advanced Topics in Radio Wave Propagation	3(3, 0)
60	ETN822	Advanced Topics in RF Planning and Optimization	3(3, 0)
61	ETN840	Special Topics in Communication Systems	3(3, 0)
62	ETN841	Advanced Topics in Communications Theory	3(3, 0)
63	ETN842	Advanced Topics in Communication Signal Processing	3(3, 0)
64	ETN843	Advanced Topics in Wireless Communications	3(3, 0)
65	ETN844	Advanced Topics in Information Theory and Coding	3(3, 0)
66	ETN845	Advanced Topics in Error Control Coding	3(3, 0)
67	ETN846	Advanced Topics in Information Security	3(3, 0)
68	ETN872	Special Topics in Computer Networks	3(3, 0)
69	ETN880	Advanced Multi-user Systems for Wireless Communications	3(3, 0)

List of Open Electives Courses:

Sr.No	Course Code	Course Title	Credit Hours
1	EEE612	Discrete Mathematics	3(3, 0)
2	EEE613	Graph Theory	3(3, 0)
3	EEE614	Engineering Optimization	3(3, 0)

4	EEE615	Probabilistic Learning: Theory and Algorithms	3(3, 0)
5	EEE616	Optimization Theory	3(3, 0)
6	EEE621	Modeling and Simulation	3(3, 0)
7	EEE630	Professional Development	3(3, 0)
8	EEE631	Professional and Technical Communication	3(3, 0)
9	EEE632	Research Methods	3(3, 0)
10	EEE640	Innovation and Technology Development	3(3, 0)
11	EEE641	Sociological Impact of Technology	3(3, 0)
12	EEE642	Science, Politics and Ethics	3(3, 0)
13	EEE650	Project Management	3(3, 0)
14	EEE651	Engineering Project Management	3(3, 0)
15	EEE690	Industrial Project-I	3(0, 3)
16	EEE691	Independent Studies-I	3(0, 3)
17	EEE692	Directed Study-I	3(0, 3)
18	EEE710	Advanced Engineering Mathematics	3(3, 0)
19	EEE711	Advanced Stochastic Processes	3(3, 0)
20	EEE712	Optimization Techniques	3(3, 0)
21	EEE714	Advanced Numerical Analysis	3(3, 0)
22	EEE715	Numerical Linear Algebra	3(3, 0)
23	EEE720	Modern Data Analysis Methods	3(3, 0)
24	EEE721	Formal Specification and Modeling	3(3, 0)
25	EEE722	Computational Biology	3(3, 0)
26	EEE723	Biologically Inspired Computing	3(3, 0)
27	EEE730	Advanced Professional Development	3(3, 0)
28	EEE740	Advanced Electrochemistry	3(3, 0)
29	EEE741	Advanced Thermal Chemistry	3(3, 0)
30	EEE750	Power Sector Deregulation	3(3, 0)
31	EEE751	Project Feasibility Study	3(3, 0)
32	EEE790	Industrial Project-II	3(0, 3)
33	EEE791	Independent Studies-II	3(0, 3)
34	EEE792	Directed Study-II	3(0, 3)

MS Project/ MS Thesis

01	EEE798	MS Project	6(0, 6)
02	EEE799	MS Thesis	6(0, 6)

Outlines of Courses in Electrical Engineering

1. ETN610 Electromagnetic Field Theory 3(3, 0)

Basic electromagnetic theory of time-varying electromagnetic fields : Maxwell's equations and boundary conditions; wave equation and its solutions; wave propagation, reflection and transmission; auxiliary vector potentials and construction of solutions; electromagnetic field theorems and their applications; guided wave and scattering boundary value problems, 1-D and 3-D green's functions with applications, integral equation formulation

2. ETN611 Microwave Passive Devices and Circuits 3(3, 0)

Guided waves, fundamental quantities and complements: Propagation conditions: modes, EM fields structure, transverse and semi-transverse modes, dispersion, Loss evaluation in guiding structures

BLT equation: Scattering (S) parameters: application to transmission lines and waveguides (single-mode and multimode structures), Radio frequency systems analysis: tubes and junctions.

Classical guiding structures: Waveguides, transmission lines, Microwave junction characterization

Usual transmission lines and coupled lines: Printed lines (micro-strip transmission lines, slot line, coplanar line), Homogeneous multi conductors transmission lines, Characteristic impedance matrix, transmission line coupling, Modal decomposition of 2-conductors structure

Filters: Reactive components based filters, Design of distributed constants circuits, Coupled lines filters, quarter-wave transformers based filters (Richard's transformation, Kuroda's identity), Surface waves filters.

Couplers: Couplers main characteristics, Ring couplers, 90° Hybrid couplers, 180° Hybrid couplers, Applications

3. ETN612 Microwave Active Devices and Circuits 3(3, 0)

Small signal microwave amplification: Transducer gain, Power gain, Available gain versus S parameters, Simultaneous match conditions, Stability factor K, Gain variations versus source and load Stability, Unconditionally stable stage, Stability circles for conditionally stable stages, Circuit Design, Matching networks examples. Practical realizations..

Low noise amplification: Noise figure and equivalent noise temperature T_e . Four noise parameters, T_e variation versus source impedance. Associated gain, Source-Pull for noise parameters measurements, Low noise transistors: MesFETs, HEMTs

Microwave oscillators: Several design models, Frequency and phase noise, Oscillator yield: "pushing", "pulling", Practical realization examples

Functional description of different devices: Mixers, Phase-shifters, detectors, step attenuators, frequency multiplicators, Design of complete equipment

Linear large signal amplification (Class A): Dynamic load line, Maximum power and maximum efficiency, Effect of transistor knee, Cripps load-pull theory. Load-Pull measurements

Symmetrical design (Push-Pull): Reduced conduction angle waveform analysis (Class AB, B, C). Linearity and maximum efficiency. Push-Pull design advantages, High frequency push-pull design using two N-channel transistors and transformers

Passive networks and power amplifiers design: Line transformers and coaxial baluns theory, Power combiners, comparison of several possible designs.

Switching mode amplifiers: Ideal amplifier: class F, Class D and Class E switching amplifiers. Efficiency enhancement using auxiliary amplifier (Doherty design)

4. ETN613 Introduction to RF Front-End Design 3(3, 0)

The course aims at providing knowledge in RF front-end design in a context of today wireless communication systems. Both system- and circuit level perspective will be addressed, supported by modeling and simulation using professional tools. Introduction, Receiver and transmitter architectures, Devices and parasitic effects, System level RF front-end design, CMOS circuit design, LNAs, Mixers and Oscillators, Introduction to RF simulation tools, Integration Issues.

5. ETN614 RF System Engineering and Design 3(3, 0)

Introduction: RF/Microwave bands, RF/microwave characteristics, RF/microwave system, traditional, industrial and biomedical applications, microwave hazards; Transmission line theory: Circuit representation of transmission line, transmission line equations, impedance and its transformation, Smith Chart and its applications. impedance

matching techniques; RF/Microwave Transmission lines: Co-axial line, rectangular and circular wave guides, introduction to strip lines, microstrip lines; Wave guide components: Transmission line resonators, Rectangular and circular cavity resonators, introduction of s-parameters, Hybrid junctions, Directional couplers, circulator; RF/Microwave measurements: VSWR, Frequency, Power, Noise, Q Factor, Impedance, Attenuation, Dielectric Constant, antenna Gain; Antennas: The transmitting mode: Equivalence Principles; integral source/fields relationships; far-field properties; radiated power and gain; input impedance; frequency bandwidth. Examples of applications: wire antennas, printed antennas, radiating apertures, arrays of antennas. ; The receiving mode: Antenna plane wave response; equivalent circuit; discussion of the received power; receiving cross-section; free-space propagation; multiple paths; equivalent noise temperature; RF Propagation: EM waves and propagation, Propagation mechanisms, Free Space Propagation, Reflection, Refraction, Ducting, Multi-path, Propagation over irregular terrain, Sample Link Budget Calculations, Link Structure, Fading Channels, Diversity Techniques
RF System Design: Modulation, Bandwidth, Interference, Performance, BER vs. Noise, Bandwidth Limitations, Noise Figure, Eb/No vs. SNR, Receiver Sensitivity, Desensitization and Blocking, Dynamic Range, Intermodulation Distortion, Power Output, Spectral Efficiency and System Limitations, Sample Link Budget Calculations, Link Structure, Design Engineering, Performance Engineering, Traffic Engineering, System Noise Management, Propagation Modes, Scattering Parameter Analysis, RF Regulatory Considerations

6. ETN615 RF Filter Design 3(3, 0)

RF system Gain and Linearity, Noise Sources, Noise Factor, Resonant Circuit, Resonant Circuit, Impedance Matching, Impedance matching circuits, Circuit design and analysis, Impedance matching components, impedance matching Questor, Transmission Lines, Smith Chart, Impedance Matching with Smith Chart, Port Network Representation & S-parameters, Transistor, Other Passive Components, LNA Overview, LNA Output Matching, LNA Input Matching, LNA Power Gain, LNA Noise, LNA Noise Factor & Stability, RF Systems, Noise factor of a cascaded system, Oscillator & Voltage Controlled Oscillator, Phase noise in Oscillator, Mixer

7. ETN616 Radio Engineering 3(3, 0)

Transmission line theory: Circuit representation of transmission line, transmission line equations, impedance and its transformation, Smith Chart and its applications, impedance matching techniques; RF/Microwave Transmission lines: Co-axial line, rectangular and circular wave guides, introduction to strip lines, microstrip lines; Wave guide components: Transmission line resonators, Rectangular and circular cavity resonators, introduction of s-parameters, Hybrid junctions, Directional couplers, circulator; RF/Microwave measurements: VSWR, Frequency, Power, Noise, Q Factor, Impedance, Attenuation, Dielectric Constant, antenna Gain; Antennas: The transmitting mode: Equivalence Principles; integral source/fields relationships; far-field properties; radiated power and gain; input impedance; frequency bandwidth. Examples of applications: wire antennas, printed antennas, radiating apertures, arrays of antennas. ; The receiving mode: Antenna plane wave response; equivalent circuit; discussion of the received power; receiving cross-section; free-space propagation; multiple paths; equivalent noise temperature; RF Propagation: EM waves and propagation, Propagation mechanisms, Free Space Propagation, Reflection, Refraction, Ducting, Multi-path, Propagation over irregular terrain, Sample Link Budget Calculations, Link Structure, Fading Channels, Diversity Techniques

RF System Design: Modulation, Bandwidth, Interference, Performance, BER vs. Noise, Bandwidth Limitations, Noise Figure, Eb/No vs. SNR, Receiver Sensitivity, Desensitization and Blocking, Dynamic Range, Intermodulation Distortion, Power Output, Spectral Efficiency and System Limitations, Sample Link Budget Calculations, Link Structure, Design Engineering, Performance Engineering, Traffic Engineering, System Noise Management, Propagation Modes, Scattering Parameter Analysis, RF Regulatory Considerations

8. ETN620 Antennas Theory, Design and Applications 3(3, 0)

Antennas constitute a key component in any radio communication system. Antenna studies require specific techniques based on electromagnetics as well as signal processing. The course provides knowledge in general properties of antennas, the electromagnetic theory behind their operation, and an overview of different antenna systems. Equal weight is placed on the electromagnetic aspects important for antenna design and on system aspects. Introduction to antennas: Antenna as interface; circuit aspect and radiation aspects; trends in the evolution of antenna techniques.

The transmitting mode: Equivalence Principles; integral source/fields relationships; far-field properties: radiated power and gain; input impedance; frequency bandwidth. Examples of applications: wire antennas, printed antennas, radiating apertures, arrays of antennas.

The receiving mode: Antenna plane wave response; equivalent circuit; discussion of the received power; receiving cross-section; free-space propagation; multiple paths; equivalent noise temperature.

Antenna design and characterization techniques: Basics of numerical techniques (method of moments, FDTD, rays). Experimental techniques: direct approach (long and compact ranges) and indirect approach (near-field).

Introduction to signal processing antennas, traveling wave antennas etc

9. ETN621 Radio Wave Propagation 3(3, 0)

Tropospheric propagation, Electromagnetic wave radiation, Reflection from earth's surface, Refraction, diffraction and scattering of waves in atmosphere, Radio-wave ducts and propagation, Free space attenuation. The role of the terrain in propagation fading mechanisms – multipath, fading. Attenuation by atmospheric gases, noise, rain attenuation. Ionospheric propagation; Parameters of ionospheric propagation. Ionospheric scattering distance, Fading of radio signals in the ionosphere. Special problems of HF radio communication associated with the equatorial ionosphere. Radio noise, Prediction techniques: Calculation and measurement of field strength, power flux density, radiation and transmission loss. CCIR prediction curves. Prediction of ionospheric field strength and propagation loss, Solar and ionospheric indices for ionospheric propagation prediction

10. ETN622 RF Propagation and Planning for Wireless Communications 3(3, 0)

EM waves and propagation, Propagation mechanisms, Free Space Propagation, Reflection, Refraction, Ducting, Multi-path, Propagation over irregular terrain, Diffraction, Ground wave, Ionospheric Reflections, Tropospheric effects, Path loss calculations, Characterization of multipath phenomenon, short term fading, Statistics of fast fading, Wideband channel characterization, Diversity, Antenna basics, Antennas for wireless communications, Point-to-point and point-to-multipoint link design, Communication Standards, Statistical Propagation models in urban and rural environments, Propagation inside buildings, Applications to cellular and mobile communications, Base station and remote sites design considerations

11. ETN630 Radar Systems 3(3, 0)

Fields and waves , Radio communications and navigation , GPS , Avionics navigation systems , Celestial navigation , Surveying , Historical Perspectives , Clocks and timing , Special relativity , Inertial navigation Kalman filtering. Advanced concepts in global navigation satellite systems (GNSS) such as the American GPS (global positioning system), the European's Galileo and the Russian's GLONASS (GLObal NAVigation Satellite System). System level description, architecture and design of a wide area augmentation system (WAAS) comprising geostationary satellites overlaying GPS satellites and its vast network of monitoring and control ground stations. The equivalent EGNOS (European Geostationary Navigation Overlay Service), a precursor to Galileo and the Japanese MSAS (Multi-transport Satellite-based Augmentation System). Updates on evolving GNSS technology and GNSS backup alternatives.

12. ETN631 Satellite Communications 3(3, 0)

Introduction to satellite system, Orbital Mechanics, Linking by satellite, Available technologies (C, Ku, K-bands), Geosynchronous orbits and LEO's (Low Earth Orbits). Satellite design, Transponder design, Satellite propagation and transmission equations, Uplink characterization, Transponder characterization, Downlink characterization, Atmospheric effects, Earth station design, Uplink amplifiers, frequency converters, modulators, Downlink amplifiers, frequency converters, demodulators, Antennas, Analog modulation techniques, Digital modulation techniques, Satellite networks architectures, FDMA, TDMA, CDMA, and packet, Inter-satellite communications, Performance evaluation, Navigation by satellite, Time Difference of Arrival Techniques, GPS Systems, Limitations to Accuracy, Economic, Business, and Regulatory aspects

13. ETN632 GPS and Navigation Systems 3(3, 0)

GPS Systems, Limitations to Accuracy, Economic, Business, and Regulatory aspects, Orbital Mechanics, Linking by satellite, Available technologies (C, Ku, K-bands), Geosynchronous orbits and LEO's (Low Earth Orbit), Satellite design, Transponder design, Satellite propagation and transmission equations, Uplink characterization.