DEPARTMENT OF ELECTRICAL ENGINEERING

PAKISTAN INSTITUTE OF ENGINEERING AND APPLIED SCIENCES (PIEAS)

NILORE, ISLAMABAD

Curriculum for

BS Electrical Engineering

(For Sessions 2015 and onward)

Members of the Board of the Studies of the Department

1. Professor Dr. Tahir Nadeem Malik, Dean Electrical Engineering, UET Taxila.
2. Dr. Jawad Ahmed Farooq, DCE, KRL,
3. Dr. Abdus Samme, DCE, CAHSNUPP, C3-C4,
4. Dr. Muhammad Shafique, DCM, NESCOM,]
5. Dr. Naeem Iqbal, Head DEE,
6. Dr. Naseem Yousaf Hamza, Head DPAM, PIEAS,
7. Dr. Haroon Rashid, DCE,
8. Dr. Muhammad Arif, PE,
9. Dr. Muhammad Tufail, PS,
10. Dr. Abdul Qayyum Khan, PE,
11. Dr. Ghulam Mustafa, PE,
12. Dr. Waqas Ahmed
13. Dr. Baber Hussain, PE,
14. Dr. Fatima Tahir

Departmental Curriculum Revision Committee

Convener

Dr Naeem Iqbal (Head DEE)

Members

1. Dr Haroon Ur Rashid

2. Dr. Muhammad Arif
3. Dr. Muhammad Tufail
4. Dr Muhammad Abid
5. Dr Abdul Qayyum Khan
6. Dr. Waqas Ahmed

Contents

BS Electrical Engineering Degree Requirement

Group	Total Credits	Percentage
Humanities	14	19.46/19.32
Management Sciences	4	5.56/5.52
Natural Sciences	24	33.36/33.12
Computing	4	5.56/5.52
Electrical Engineering Foundation	27	38.92/38.64
Electrical Engineering breadth	19(P); 26 (E and T)	31.97/35.88
Electrical Engineering Electives	32 (P); 24 (E and T)	38.92/33.12
Interdisciplinary engineering	8	11.12/11.04
Thesis project	6	8.34/8.28
Total	**138/137**	

Pakistan Engineering Council Compliance

Total Number of Available Course	66
Total Number of Courses to Study	43
Total Number of Credit Hours	139/137,138
Credit Hours for Engineering Courses	93/91,92
Credit Hours for Non-Engineering Courses	46
Percentage of Engineering Courses Credit Hours	67
Percentage of Non-Engineering Courses Credit Hours	33

List of Courses

Course Coding

Each course has been assigned a code **XX-YSN** according to the following scheme:

XX: Code for the Department offering the course

EE: Electrical Engineering

PAM: Physics and Applied Mathematics

CMS: Communication and Management Sciences

ME: Mechanical Engineering

NE: Nuclear Engineering

Y: Year of study (first, second, third, four)

SN: Serial Number assigned to the course

Sr. No.	Group		Code	Title	Credit Hours	Total Credits	Pre-Requisites
1.	Humanities	Culture	CMS-101	Islamic Studies (For Muslims)	2+0	14	Nil
			CMS-102	Ethics (For Non-Muslims)			Nil
2.			CMS-103	Pakistan Studies	2+0		Nil
3.		English	CMS-104	Composition and Grammar	2+0		Nil
4.			CMS-105	Communication Skills	3+0		Nil
5.			CMS-106	Technical Writing	3+0		Nil
6.		Social Sciences	CMS-109	Entrepreneurship	2+0		Nil
7.			CMS-207	Professional Ethics	2+0		Nil
8.	Management Sciences		CMS-202	Engineering Economics	2+0	4	Nil
9.			CMS-301	Principles of Management	2+0		Nil
10.	Natural Sciences	Math	PAM-101	Calculus-I	3+0	24	Nil
11.			PAM-202	Calculus-II	3+0		PAM-101
12.			PAM-242	Linear Algebra	2+0		PAM-202
13.			PAM-256	Ordinary Differential Equations	3+0		PAM-101
14.			PAM-260	Complex Analysis and Applications	3+0		PAM-256
15.			PAM-266	Probability and Random Variables	3+0		Nil

16.			PAM-361	Engineering Computational Methods	3+0		PAM-242,PAM-256
17.		Physics	PAM-131	Engineering Physics	3+1		Nil
			PAM-131L	Engineering Physics Lab			
						42	
18.	Computing		CIS-101	Computer Fundamentals and Programming	3+1	4	Nil
			CIS-101L	Computer Fundamentals and Programming Lab			
19.	Electrical Engineering Foundation 19(P) 26(E and T)		EE-111	Circuit Analysis-I	3+1	27	Nil
			EE-111L	Circuit Analysis-I Lab			
20.			EE-120	Electronic Devices and Circuits	3+1		EE-111
			EE-120L	Electronic Devices and Circuits Lab			
21.			EE-212	Electronic Circuit Design	3+1		EE-120
			EE-212L	Electronic Circuit Design Lab			
22.			EE-213	Electrical Machines	3+1		PAM-131 EE-223
			EE-213L	Electrical Machines Lab			

23.		EE-220	Signals and Systems Theory	3+0		PAM-260
24.		EE-224	Digital Logic Design	3+1		EE-111
		EE-224L	Digital Logic Design Lab			
25.		EE-226	Circuit Analysis-II	3+1		EE-111, PAM-256
		EE-226L	Circuit Analysis-II Lab			
26.	Electrical Engineering (Breadth)				19(P) 26(E and T)	
27.		EE-311	Microprocessors and Interfacing	3+1		EE-224
		EE-311L	Microprocessors and Interfacing Lab			
28.		EE-312	Measurement and Instrumentation	3+1		EE-111
		EE-312L	Measurement and Instrumentation Lab			
29.		EE-313	Electromagnetic Theory	3+0		PAM-202
30.		EE-316	Integrated Circuits	3+1		EE-212
		EE-316L	Integrated Circuits			
31.		EE-323	Communication Systems	3+1		EE-313, PAM-266
		EE-323L	Communication Systems Lab			
32.		EE-325	Electrical Power Systems	3+0		EE-223

33.		EE-416	Linear Control Systems	3+1		PAM-256
		EE-416L	Linear Control Systems Lab			
34.	Electrical Engineering (*Electives)	EE-310	Analog Filter Design	3+1	32(P) 24(E and T)	EE-226
		EE-310L	Analog Filter Design Lab			
35.		CIS-315	Introduction to Artificial Intelligence	3+1		Nil
		CIS-315L	Introduction to Artificial Intelligence Lab			
36.		CIS-318	Data Structures and Algorithms*	2+1		CIS-101
		CIS-318L	Data Structures and Algorithms Lab*			
37.		EE-324	Power Generation	3+1		EE-213
		EE-324L	Power Generation Lab			
38.		EE-326	Data and Computer Communication	3+1		Nil
		EE-326L	Data and Computer Communication Lab			
39.		EE-327	FPGA Based Design	3+1		EE-224
		EE-327L	FPGA Based Design Lab			
40.		EE-410	Modern Electronic Manufacturing Process	3+1		EE-212

		EE-410L	Modern Electronic Manufacturing Process Lab			
41.		EE-411	Power Electronics	3+1		EE-120
		EE-411L	Power Electronics Lab			
42.		EE-412	Transmission Lines & Waveguides	3+1		EE-323
		EE-412L	Transmission Lines & Waveguides Lab			
43.		EE-414	Digital Signal Processing	3+1		EE-220
		EE-414L	Digital Signal Processing Lab			
44.		EE-415	Power Systems Analysis	3+1		EE-223
		EE-415L	Power Systems Analysis Lab			
45.		EE-418	Power Transmission, Distribution and Utilization	3+1		EE-415
		EE-418L	Power Transmission, Distribution and Utilization Lab			
46.		EE-419	Electrical Machine Design	3+1		EE-223
		EE-419L	Electrical Machine Design Lab			
47.		EE-420	Electrical Motor Drives	3+1		EE-411

		EE-420L	Electrical Motor Drives Lab			
48.		EE-421	Antenna Theory & Design	3+1		EE-412
		EE-421L	Antenna Theory & Design Lab			
49.		EE-422	VLSI Design	3+1		EE-316
		EE-422L	VLSI Design Lab			
50.		EE-423	Digital Control Systems	3+1		EE-416
		EE-423L	Digital Control Systems Lab			
51.		EE-424	Computer System Architecture	3+1		EE-311
		EE-424L	Computer System Architecture Lab			
52.		EE-425	Fundamentals of Robotics	3+1		PAM-242
		EE-425L	Fundamentals of Robotics Lab			
53.		EE-426	Industrial Automation	3+1		EE-416
		EE-426L	Industrial Automation Lab			
54.		EE-427	Digital Communication Systems	3+1		EE-323
		EE-427L	Digital Communication Systems Lab			
55.		EE-428	Renewable Energy Systems	3+1		EE-223
		EE-428L	Renewable Energy Systems Lab			

56.		EE-429	Wireless and Mobile Communication	3+1		EE-323
		EE-429L	Wireless and Mobile Communication Lab			
57.		EE-430	High Voltage Engineering	3+1		EE-312
		EE-430L	High Voltage Engineering Lab			
58.		EE-431	Power Systems Operation and Control	3+1		EE-415
		EE-431L	Power Systems Operation and Control Lab			
59.		EE-432	Power System Protection	3+1		EE-418
		EE-432L	Power System Protection Lab			
60.		EE-433	Power System Quality	3+1		EE-415
		EE-433L	Power System Quality Lab			
61.	Inter-Disciplinary Engineering	ME-122	Workshop Practice	0+1	8	Nil
62.		ME-196	Engineering Drawing	0+1		Nil
63.		ME-198	Engineering Mechanics	2+1		Nil
		ME-198L	Engineering Mechanics Lab			
64.		ME-199	Applied Thermodynamics	3+0		Nil

65.		NE-404	Basic Nuclear Engineering	3+0		PAM-131
66.	Thesis Project	EE-499	Thesis Project	06	6	The student should pass 70% of the total Credit Hours of course work.
				Total	97/(96	
				Credit Hours of the Whole Program	42 + 96/(95) = 138/(137)	

*In the case of elective courses, the students can also register in MS Systems Engineering courses with course codes EE-5XX

Note: For courses with 4 (3+1) credit hours, the students will separately register in theory (3 credit hours) and lab (1 credit hour). Accordingly, the students have to repeat only the part (theory and/or lab) in which he/she was failed.

Semester wise Distribution

Semester (Year)	Sr. No.	Code	Subject	Credit Hours		Prerequisites
				Theory	Lab	
I (Year 1)	1	PAM-131	Engineering Physics	3	1	Nil
	2	CMS-101/ CMS-102	Islamic Studies / Ethics	2	0	Nil
	3	PAM-101	Calculus-I	3	0	Nil
	4	EE-111	Circuit Analysis - I	3	1	Nil
	5	CIS-101	Computer Fundamentals and Programming	3	1	Nil
	6	CMS-104	Composition and Grammar	2	0	Nil
			Total	**16**	**3**	**19**
II	1	PAM-202	Calculus-II	3	0	PAM-101
	2	EE-120	Electronic Devices and Circuits	3	1	EE-111
	3	ME-198	Engineering Mechanics	2	1	Nil

(Year 1)	4	PAM-256	Ordinary Differential Equations	3	0	PAM-101
	5	ME-196	Engineering Drawing	0	1	Nil
	6	CMS-105	Communication Skills	3	0	Nil
			Total	**14**	**3**	**17**
III (Year 2)	1	PAM-242	Linear Algebra	2	0	PAM-202
	2	EE-212	Electronic Circuit and Design	3	1	EE-120
	3	EE-226	Circuit Analysis-II	3	1	EE-111, PAM-256
	4	EE-224	Digital Logic Design	3	1	EE-111
	5	PAM-260	Complex Analysis and Applications	3	0	PAM-256
	6	CMS-103	Pakistan Studies	2	0	Nil
			Total	**16**	**3**	**19**

IV (Year 2)	1	EE-220	Signals and Systems Theory	3	0	PAM-260
	2	EE-311	Microprocessors and Interfacing	3	1	EE-224
	3	ME-199	Applied Thermodynamics	3	0	Nil
	4	EE-213	Electrical Machines	3	1	PAM-131
	5	CMS-106	Technical Writing	3	0	Nil
	6	ME-122	Workshop Practice	0	1	Nil
			Total	**15**	**3**	**18**
V (Year 3)	1	EE-312	Measurement and Instrumentation	3	1	EE-111
	2	EE-313	Electromagnetic Theory	3	0	PAM-202
	3	EE-316	Integrated Circuits	3	1	EE-212
	3	EE-419	Electrical Machine Design	3	1	EE-213
	4	PAM-266	Probability and Random Variables	3	0	Nil
	5	CMS-202	Engineering Economics	2	0	Nil
			Total	**14**	**2**	**16**

VI (Year 3)	1	PAM-361	Engineering Computational Methods	3	0	PAM-242, PAM-256
	2	EE-323	Communication Systems	3	1	EE-313, PAM-266
	3	EE-411	Power Electronics	3	1	EE-120
			Power Specialization			
	4	EE-324	Power Generation	3	1	EE-213
	5	EE-418	Power Transmission, Distribution and Utilization	3	1	EE-415
			Electronics and Telecommunication Specialization			
	4	EE-410	FPGA Based Design	3	1	EE-212
	5	EE-414	Digital Signal Processing	3	1	EE-220
			Total	**15**	**4**	**19**
VII (Year 4)	1	EE-416	Linear Control System	3	1	PAM-256
	2	CMS-301	Principles of Management	2	0	Nil
	3	EE-499	Thesis Project	0	3	The student should pass 70% of the total Credit Hours of course work.

		3Power Specialization			
4	EE-415	Power Systems Analysis	3	1	EE-223
5	EE-432	Power System Protection	3	1	EE-418
		Electronics and Telecommunication Specialization			
4	EE-325	Electrical Power Systems	3	0	EE-223
		Select one of the following			
5	EE-425	Fundamentals of Robotics	3	1	PAM-242
5	EE-326	Data and Computer Communication	3	1	Nil
5	CIS-318	Data Structures and Algorithms*	2	1	CIS-101
		Total	**11/(10*)**	**6(5)**	**17(16)**
VIII					
1	CMS-109	Entrepreneurship	2	0	Nil
2	EE-499	Thesis Project	0	3	The student should pass 70% of the total Credit Hours of course work.

(Year 4)			**Power Specialization**			
	3	EE-431	Power System Operation and Control	3	1	EE-415
	4	EE-430	High Voltage Engineering	3	1	EE-312
			Electronics and Telecommunication Specialization			
	3	EE-412	Transmission Line and Waveguide	3	1	EE-323
			Select one of the following			
	4	EE-423	Digital Control Systems	3	1	EE-416
	4	EE-426	Industrial Automation	3	1	EE-416
	4	EE-427	Digital Communication Systems	3	1	EE-323
			Total	**8**	**5**	**13**

DETAILED CONTENTS

HUMANITITES

CMS-101 ISLAMIC STUDIES

Status	C
Credits	2+0
Prerequisite	Nil

Tauheed; Arguments for the Existence and Oneness of Allah; Purpose of Creation; Impact of Tauheed on Human Life. Risalat; Need for Prophets; Finality of Prophet hood; Seerat; KhutbaHijjat-ul-Wida; The Importance of Sunnah. Aakhirat; The Life after Death; The Day of Judgment; The Concept of Accountability and its Impact on Daily Life; The Holy Quran, its Revelation and Compilation; Introduction to Aijaaz-ul-Quran and the Principles of Tafseer-ul-Quran; Sura al-Fatiha; 1st Raku of Sura al-Baqarah; Sura Al-Hujraat and Lessons from SuraYaseen. Hadith; Its Authenticity and Importance; An Introduction to Sihah-i-Sitta; Types of Ahadith; Chehal hadith (Forty Ahadith).Ibadah; The Concept of Ibadah; Salaat, Saum, Zakat, Hajj and Jihad; Moral, Social and Political Philosophy of Islam; Concept of Good and Evil; Akhlaq-i-Hasanah, Kasb-i-Hilal; Responsibilities of the Head of the State; Rights and Duties of the Citizens; Applications of Islamic Teachings to Social and Economic Developments of the Modern Age.

Recommended Texts:

1. Ibn-i-Kasir, *TafseerIbn-i-Kasir,* Dar IbnHazam, Beirut, Lebanon, 2005.
2. B. Baqilani, *Al-IntisaarLil-Quran,* Dar IbnHazam, Beirut, Lebanon, 2005.
3. Mir Muhammad Kutabkhana, *MajalisulAbrar (for forty Ahadith),* Markaz-i-Ilm-o-Adab Karachi, 2005.
4. Imam Nauwwi, *ArbaeenHadit,* Mir Muhammad Kutabkhana, Markaz-i-Ilm-o-Adab Karachi, 2005.

CMS-103 PAKISTAN STUDIES

Status	**C**
Credits	**2+0**
Prerequisite	**Nil**

Movement; The Founding Documents of Pakistan; AllamaIqbal's 1930 Allahabad Address; The Lahore Resolution of 23rd March 1940; Quaid-i-Azam's Presidential Address to the Constituent Assembly of Pakistan; Political and Constitutional Phases in Pakistan since 1947; Important Features of the 1973 Constitution and its Current Status; Current Issues and Problems including Administrative Infra-structure, Population Growth, Water, Energy and Mineral Resources, Agricultural Resources and Industrial Infra-structure, Educational problems, Economic Growth Pattern and Budgetary Issues, Environmental Problems, Foreign Policy.

Recommended Texts:

1. K. A. Saeed, The Economy of Pakistan, Oxford University Press, Karachi, 2007.
2. J.Briscoe and U. Qamar, Pakistan's Water Economy: Running Dry, Oxford University Press, 2006.
3. J.M. Kenoyer, Ancient Cities of the Indus Valley Civilization, Oxford University Press, Karachi, 1998.
4. L.A. Sherwani (Editor), Speeches ,Writings and Statements of Iqbal, Iqbal Academy, Lahore, 1995.
5. L.A. Sherwani (Editor), The New Oxford Atlas for Pakistan, Oxford University Press, Karachi, 1998.

CMS-202 ENGINEERING ECONOMICS

Status	**C**
Credits	**2+0**
Prerequisite	**Nil**

Principles of Engineering Economy; Cost Concepts and Design Economics; Time Value of Money; Applications of Time-Money Relationships (MARR, PW, FW, AW, IRR, ERR and Payback period methods); Comparison Methods; Depreciation; Cost Estimation Techniques; Replacement Analysis; Taxes; Inflation.

Specific Goals for the Course: This course is designed to equip students to acquired principles and methods of engineering economy. The course has two primary purposes. First is to provide students with a sound understanding of the principles, basic concepts, and methodology of engineering economy. Second is to help them develop proficiency with these methods for making rational decisions regarding situations in professional practices.

Recommended Texts:

1. W. G. Sullivan, J. A. Bontadelli and E. M. Wicks, *Engineering Economy*, Prentice Hall Inc., 11th Edition, 1999.
2. C. S. Park, and G. P. Sharp-Bette, *Advanced Engineering Economics*, John Wiley and Sons Inc., 10th Edition, 1990.
3. J. Knutson and I. Bitz, *Project Management: How to Plan and Manage Successful Projects*, American Management Association, 1991.

CMS105-COMMUNICATION SKILLS

Status	**C**
Credits	**3+0**
Prerequisite	**Nil**

Overview and Importance of Effective Communications; Business Communication and the Ethical Context; Business Communication and the Technology Context; Successful Listening; Communicating in Teams and Mastering Listening and Nonverbal Communication Skills; Strategies for Successful Speaking and Successful Listening; Leading by Feel; Logical Fallacies and the Art of Debate; General principles of Communication; The Seven C's of Effective Communication; Format and Layout of Business Documents; Preparing Effective Business Messages; Good News; Bad News and Neutral Messages; Persuasive Written Messages; Writing Resumes and Application Letters; Interviewing for Employment and Following Up; Reports; Proposals and Presentations; Research Process; Communicating Information Through Visuals; Short Reports; Formal Reports; Proposals; Oral Communication; Impromptu and Extempore Talks ; Onion Ring Activity; Individual Talks; Meetings and Group Dynamics; Member Roles and Leadership in Groups; Communicating in Teams; Mastering Listening; Nonverbal Communication Skills; Strategies for Business and Group Meetings; Preparation for Presentations; Planning, writing, and Completing Oral Presentations; Strategies for Successful Speaking and Successful Listening.

Recommended Texts:

1. J. V. Thill and C. L. Bovee, *Business Communication Today*, Prentice-Hall, 8th Edition, 2004.
2. T. Fulwiler, A.R. Hayakawa and C. Kupper, *The College Writer's Reference*, Prentice Hall, 1999.
3. H. A. Murphy, H. W. Hildebrandt and J.P. Thomas, *Effective Business Communications*, Mcgraw-Hill/Irwin, 8th Edition, 1997.
4. Corporate Classrooms, *Get a Grip on Grammar, Language Skills for Today's Business World*, Prentice Hall, 1992.

CMS-104 COMPOSITION AND GRAMMAR

Status	**C**
Credits	**2+0**
Prerequisite	**Nil**

Pre-writing techniques (cubing, looping, mind-maps, brainstorming, free-writing, narrowing and Focusing), Audience, Voice, Critical Reading and Analysis, Thesis Statements, Outlining and Organizing the Essay, Introductory Paragraphs , Developing the Essay, Paragraphing, Summary and Paraphrase, Basic Sentence Analysis/Usage, Correct sentences, Paragraph types including exemplification, narration, comparison/contrast, cause/effect, and persuasion, Fallacies in argumentation, Claim, Support, and Warrant, Counterarguments/Rebuttals, Revision Techniques and Editing. Grammar: Figures of Speech, sentence elements, sentence types, coordination & subordination, verb tenses, sentence types, fragments, run-ons, subject-verb agreement, count/non-count nouns, and modals. Mechanics: commas, capitalization and punctuation.

Specific Goals for the Course:

1. To provide students with a course that focuses on their needs as learners of English in the present day.
2. To train students in the communicative use of contemporary English for practical purposes.
3. To provide material not only to extend the students' general language proficiency but also to systematically develop their abilities to use English as a tool for study and to prepare them for their future careers.

Recommended Texts:

1. P. Hartmann and L. Blass, Quest 2 – *Reading and Writing*, McGraw-Hill ESL/ELT, 2nd Edition, 2007.
2. P. Hartmann and L. Blass, Quest 2 – *Listening and Speaking*, McGraw-Hill ESL/ELT, 2nd Edition, 2007.
3. M. J. Kolln and R. W. Funk, *Understanding English*, Longman, 7th Edition, 2005.
4. E. Balleisen and S. K. Bland, *Intermediate Grammar: From Form to Meaning*, Oxford University Press, USA; Teacher's Edition, 1996.

CMS-109 ENTREPRENEURSHIP

Status	**C**
Credits	**2+0**
Prerequisite	**Nil**

Introduction to Entrepreneurship; Entrepreneurial Process; Business Opportunity Identification; Market Assessment; Financing the Emerging Firm; New Product Innovation; Technology Commercialization; Business Plan Development; Strategy and Entrepreneurship; Managing the

Recommended Texts:

1. P. F. Drucker, *Innovation and Entrepreneurship*, Butterworth-Heinemann, 2007.
2. P. Burns and J. D. Hurst, *Small Business and Entrepreneurship*, Palgrave Macmillan, 1st Edition, 2001.
3. P. N. Singh, *Entrepreneurship for Economic* Growth, Vikas Publishing.
4. J. B. Miner, *Entrepreneurial Success*, Berrett-Koehler Publishers, 1996.

CMS-106 TECHNICAL WRITING

Status	C
Credits	3+0
Prerequisite	Nil

Overview of the Field; Manuals and Handbooks; Technical Reports; Technical Articles; Technical Sales Literature; Technical Training Material; Technical Presentations; Educational Textbooks; Software Documentation; Outline and Design; The Requirement Specification; The Outline Design; Sources of Information; Library Classifications; Contacts; Meetings; Information Gathering; Verbal Information; Visual Information; The Synopsis; The Work Schedule; Costing; Development Phase; First Draft; Style of Writing; Technical Vetting; Editing; Final Draft; Commercial Books; Production Phase: Camera Copy; Proofreading; Printing; Illustrations: Technical Illustrations; Diagrams/Line Illustrations; Perspective Drawings; Half-tones; Validating Illustrations; Translations; Abstracting and Abridging; Indexing; Development of a Documentation System; Diagnostic/Maintenance Documentation; Network Planning; Copyright; Contracts.

Recommended Texts:

1. Tech Biz Writing, *TechBiz Writing Course: A free course in technical and business writing which builds gradually into a valuable resourse*, http://www.techbizwriting.com.
2. R. W. Kristin, *Writing for the Technical Professions*, Longman, 4th Edition, 2007.

CMS-207 PROFESSIONAL ETHICS

Status	**C**
Credits	**2+0**
Prerequisite	**Nil**

Ethical Concepts and Principles; Understanding the Codes of Conduct; Caring for Company Assets; Avoiding Conflicts of Interest; Confidential Information and Intellectual Property; Business Gifts and Hospitality; Electronic Communications; Antitrust and Fair Competition; Ethics in Research, Documentation and Treatment of Research Data; Reporting and Assistance; Deception; Harassment and Bullying; Privacy and Confidentiality; Cultural Conflicts; Misunderstanding and misusing Jokes, Innuendos, and Banter at work; Lack of Stewardship of Company Assets (funds, physical property, intellectual property); Cheating and Plagiarism by Students and Researchers; Identifying and Resolving Ethical Dilemmas; Need for and Characteristics of a Corporate-level Ethics Program; Best Practices in the Development of Code of Ethics; Embedding an Ethics Policy (and Code) into the day to day working of an Organization; Training Methods; Characteristics of an Effective Corporate Ethics Program; Corporate Social Responsibilities.

Recommended Texts:

1. M. W. Martin, M. Martin and R. Schinzinger, *Ethics in Engineering*, McGraw-Hill, 2004.
2. C. Mitchell, *A Short Course in International Business Ethics: Combining Ethics and Profits in Global Business*, World Trade Press, 2003.
3. J. C. Callahan, *Ethical Issues in Professional Life*, New York: Oxford University Press, 1988.

CMS-301 PRINCPLES OF MANAGEMENT

Status	**C**
Credits	**2+0**
Prerequisite	**Nil**

Introduction to Management and Organizations; Organizational Vision, Mission and Strategies; Organizational Culture; Socially Responsible Organizations; Foundations of Planning; Planning Tools and Techniques; Organizational Structure and Design; Human Resource Management; Foundations of Behavior; Leadership and Motivation; Operations and Value Chain Management; Performance Management; Project Portfolio Management System; Project Networks; Scheduling; Resource Allocation and Resource Leveling; Project Execution and Controlling; Introduction to PMBOK.

Recommended Texts:

1. C. F. Gray and E. W. Larson, *Project Management: The Managerial Process*, Boston: McGraw-Hill/Irwin, 2008.
2. S. P. Robbins and M. Coulter, *Management*, Prentice Hall, 9th Edition, 2007.
3. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, 3rd Edition, Project Management Institute.

NATURAL SCIENCES

PAM-101 CALCULUS-I

Status	C
Credits	3+0
Prerequisite	Nil

Functions, Limits and Continuity; Derivatives and its Applications; Rules of Differentiation; Implicit Differentiation; Extreme Values of Functions; Mean Value Theorem; Linearization and Differentials Integration and its Applications; Indefinite integrals; Rules of Integration; Riemann Sum; Definite Integrals; Improper Integrals; Integration by Parts; Partial Fractions; Trigonometric Substitution; LHospital Rule; Infinite Series; Limits of Sequence of Numbers; Series of Non-negative Terms; Power Series; Taylor and Maclaurin Series; Application of Power Series.

Recommended Texts:

1. G. B. Thomas and R. L. Finney, *Calculus and Analytic Geometry*, AWL, 10th Edition, 2002
2. E. Kreyszig, *Advance Engineering Mathematics*, John Wiley and Sons, 9th Edition, 2005.
3. W. Kaplan, *Advanced Calculus*, Addison-Wesley, 5thEdition, 2002.
4. R. Ellis, D. Gulick, *Calculus: One and Several Variables*, Saunders College Publishing, 1991.

PAM-131 ENGINEERING PHYSICS

Status	C
Credits	3+1
Prerequisite	Nil

Measurement, Motion in a Plane, Forces and Equilibrium, Newton's Laws, Applications of Newton's Law, Rotation, Torque, Rigid Bodies, and Rotational Dynamics, Work and Potential Energy, Collisions and Conservation Laws, Universal Gravitation, Waves and Oscillations, Simple Harmonic Motion, Wave Speed, Energy and Power of Traveling Waves, Doppler`s Effect, Nature and Propagation of Light.

Specific Goals for the Course:

The objective of this course is to provide Electrical Engineering students to have a clear understanding of basic physics principles, laws and their limitations In order to solve engineering problems.

Recommended Texts:

1. R. Resnik, D. Halliday and K. S. Krane*, Physics, Volume-I and II*, John Wiley and Sons Inc., N. Y., 5th Edition, 2007.
2. R. A. Serway*, Physics for Scientists and Engineers with Modern Physics, Volume-One*, Saunders College, Publishing, Philadelphia, 2007.
3. H. D. Young, R.A. Freedman, T. R. Sandin and A. L. Ford, *University Physics*, Addison-Wesley, 2006.

PAM-202 CALCULUS-II

Status	**C**
Credits	**3+0**
Prerequisite	**PAM-101**

Vectors in the Plane and Polar Functions; Dot Products; Vector Valued Functions; Modelling Projectile Motion; Polar Coordinates and Graphs; Calculus of Polar Curves; Vectors and Motion in Space; Cartesian Coordinates and Vectors in Space; Dot and Cross Product; Lines and Plane in Space; Cylinders and Quadric Surfaces; Vector Valued Functions and Space Curves; Arc Length and Unit Tangent Vector; Multivariable Functions and Their Derivatives; Limits and Continuity in Higher Dimensions; Partial Derivatives; The Chain Rule; Linearization and Differentials; Extreme Values and Saddle Points; Lagrange Multiplier; Partial Derivatives with Constrained Variables; Taylor's Formula for Two variables; Multiple Integrals; Double integrals; Areas, Moments and Centre of Mass; Double Integral in Polar and Rectangular Coordinates; Masses and Moments in Three Dimensions; Triple Integrals in Rectangular and Spherical Coordinates; Integration in Vector Field; Work, Circulation and Flux; Path Independence; Potential Functions and Conservative Fields; Green's Theorem in Planes; Surface Area and Surface Integrals; Parameterized Surface; Stokes Theorem; Divergence Theorem and Unified Theory.

Recommended Texts:

1. G. B. Thomas and R. L. Finney, *Calculus and Analytic Geometry*, AWL, 10th Edition, 2002.
2. E. Kreyszig, *Advance Engineering Mathematics*, John Wiley and Sons, 9th Edition, 2005.
3. H. Anton,I. C. Bivens, and S. Davis,*Calculus*, Willey,10th Edition, 2012.

PAM-242 LINEAR ALGEBRA

Status	C
Credits	2+0
Prerequisite	PAM-202

System of Linear equations; Introduction to Matrices and Their Properties; Elementary Row Operations; Echelon Forms; Gaussian elimination method; Gauss-Jordan method; Rank and Inverse of a Matrix; Determinants; Vector Spaces; Linear Combination; Linear Transformation; Eigenvalues and Eigenvectors; Orthogonality and Least Squares; Symmetric Matrices and Quadratic Forms.

Recommended Texts:

1. D. C. Lay,*Linear Algebra and its Applications*, Pearson Education, 3rd Edition, 2008.
2. A. Howard and C. Rorres, *Elementary Linear Algebra*, John Wiley and Sons, 9th Edition, 2005.
3. G. Strang, *Linear Algebra and its Applications*, Harcourth Brace Jovanovich, 3rd edition, 1998.

PAM -256 ORDINARARY DIFFERENTIAL EQUATIONS

Status	C
Credits	3+0
Prerequisite	PAM-101

First Order Differential Equations; Linear Equation with Variable Coefficients; Separable Equations; Exact Equation and Integrating Factor; The Existence and Uniqueness Theorem; Mathematical Modeling with Differential Equation; Higher Order Differential Equations; Homogeneous Equations with Constant Coefficients; Linear Independence and Wronskian; Characteristic Equations and Types of Roots; Non-homogeneous Differential Equations; Method of Undetermined Coefficients; Method of Variation of Parameters; System of Linear Differential Equations; Eigenvalue Method; Series Solution of Second Order Differential Equations; Laplace Transform of Elementary Functions; Properties of Laplace transform; Periodic Functions and Their Laplace Transform; Inverse Laplace Transform and its Properties; Convolution Theorem; Heaviside's Expansion Formula; Solution of Ordinary Differential Equations by Laplace Transform.

Recommended Texts:

1. E. Kreyszig, *Advance Engineering Mathematics*, John Wiley and Sons, 9th Edition, 2005.
2. W. E. Boyce and R. C. DiPrima, *Elementary Differential Equations*, John Willey, 7th Edition, 2001 .

PAM -260 COMPLEX ANALYSIS AND APPLICATIONS

Status	C
Credits	3+0
Prerequisite	PAM-256

Complex Numbers; Complex Variables; Argand's Diagram; Modulus and Argument of a Complex Number; Polar Form; De-Moivre's Theorem; Complex Functions; Analytical Functions; Harmonic and Conjugate; Harmonic Functions; Cauchy-Riemann equations in Cartesian and Polar Coordinates; Line Integrals; Green's Theorem; Cauchy's Theorem; Cauchy's Integral Formula; Singularities, Poles, Residues and Contour Integration; Fourier Series; Fourier Cosine and Sine Series; Fourier Integrals and Transforms; Basic concepts of Partial Differential Equations; Modelling of various physical systems and phenomena by partial differential equations and their solution by Courier Series, Integrals and Transforms.

Recommended Texts:

1. E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 9th Edition, 2005.
2. J. W. Brown and R. V. Churchill, *Complex Variables and Applications,* McGraw-Hill, 7th Edition, 2003.

PAM-266 PROBABILITY AND RANDOM VARIABLES

Status	**C**
Credits	**3+0**
Prerequisite	**Nil**

Introduction to Statistics; Samples and Populations; Role of Probability; Measures of Central Tendency; Measures of Dispersion; Graphical Methods of Data Description; Concepts of Probability; Set Theory and Sample Spaces; Probability Axioms; Independent Events Permutations, Combinations; Joint Probability; Conditional Probability; Bayes' Rule; Sequential Experiments; Probability Law; Continuous and Discrete Random Variables; Probability Density and Cumulative Distribution Functions; Expected Values and Variance; Functions of a Random Variable, Chebyshev Inequalities; Moments and Characteristic Functions; Multiple Random Variables; Joints Distribution and its Properties; Joint Density and its Properties; Conditional Distribution and Density; Functions of Multiple Random Variables; Sum of Random Variables; Long Term Averages; Basic Random Processes; Stationarity and Independence; Correlation Functions; Power Spectral Density; Gaussian, Poisson and Markov Processes.

Recommended Texts:

1. L. Garcia, *Probability and Random Variables for Electrical Engineers*, Pearson Publishers, 2005.
2. A. Papoulis, *Probability, Random Variables and Stochastic Processes*, McGraw Hill, 1984.
3. W. DeCoursey, *Statistics and Probability for Engineering Applications*, Newnes, 2003.
4. T. T. Soong, *Fundamentals of Probability and Statistics for Engineers*, John Wiley and Sons, 2004.

PAM-361 ENGINEERING COMPUTATIONAL METHODS

Status	C
Credits	3+0
Prerequisite	PAM-242, PAM-256

Introduction to Numerical Methods and Numerical Analysis; Concept of Error, Accuracy and Stability; Solution of equation in one variable; Interpolation and Polynomial Approximation, Systems of Linear Equations, Numerical Differentiation and Integration: Richardson's Extrapolation, Romberg's Integration, Gaussian Quadrature. Numerical Solution of Differential Equations: Euler's Method, RK Method, Variable multistep methods, Stability; Approximation Theory: Orthogonal polynomial and Least Squares Approximation.

Matlab / Mathcad basics; Applications of Matlab / Mathcad to solve following problems: Solutions of equations of one variable, Numerical differentiation, Numerical Integration, Solution of linear system of equations using direct and iterative techniques, Solution of nonlinear system of equations.

Recommended Texts:

1. R. L. Burden, J. D. Faires, *Numerical Analysis*, Brooks Cole, 10th Edition, 2010.
2. E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 9th edition 2005.

ELECTRICAL ENGINEERING FOUNDATION

EE-111 CIRCUIT ANALYSIS-I

Status	**C**
Credits	**3+1**
Prerequisite	**Nil**

Circuit variables: Voltage and current, Power and Energy; Circuit Elements: voltage and current sources, resistor, Ohm's Law, Kirchhoff's Law, Dependent sources; Simple resistive circuits; Techniques of circuit analysis: Node voltage method, Mesh current method, Thevenin and Norton Equivalents, Maximum Power Transfer, Superposition; Inductance, Capacitance and Mutual Inductance;

Sinusoidal Steady State Analysis; Sinusoidal Steady Power Calculations; Balanced Three Phase Circuits; Operational Amplifier Circuits.

Recommended Texts:

1. J. W. Nilsson and S. A. Riedel, *Electric Circuits*, Princtice Hall, 8th Edition, 2008.
2. M. E. Van Valkenburg, *Network Analysis*, Prentice Hall India, 3rd Edition, 2007.
3. J. D. Irwin, *Basic Engineering Circuit Analysis*, Prentice Hall, 7th Edition, 2001.
4. A. H. Robbins and W. C Miller, *Circuit Analysis: Theory and Practice*, 3rd Edition, 2003.

CIS-101-COMPUTER FUNDAMENTALS AND PROGRAMMING

Status	**C**
Credits	**3+1**
Prerequisite	**Nil**

Fundamental ideas about computers and Programming, central processing unit, memory, program, data storage, program execution, fetch-decode-execute cycle, number system, input and output (I/O) devices, buses, I/O interfaces, operating systems, Programming languages, process of developing programs, algorithms, flow charts, introduction to C++, Basic constructs of the language: variables and reading/writing, expressions, operators, if statement, while statement, for statement, arrays, Functions: Function declaration, declaration scope and visibility, reference parameters, recursive functions, Types: Enumerated types, pointers, void type, object oriented program development.

Recommended Texts:

1. P. K. Sinha, *Computer Fundamentals*, BPB Publications, 2004.
2. R. Lafore, *Object-Oriented Programming in C++*, Sams Publisher, 4th Edition, 2002.
3. B. Stroustrup, The C++ Programming Language: Addison Wesley, Special 3rd Edition, 2000.

EE-120 ELECTRONIC DEVICES AND CIRCUITS

Status	**C**
Credits	**3+1**
Prerequisite	**EE-111**

Semiconductor Basics; PN Junction Diode; Voltage and Current Characteristic; Zener Diodes; Rectifier Circuits, Clipping and Clamping Circuits; Schottky-Barrier, Varactors, Photodiodes and Light-Emitting Diodes; SPICE Diode Model and Simulation; Bipolar Junction Transistor (BJT); BJT Biasing; Current-Voltage Characteristics; BJT as Amplifier and Switch; Common Base, Common Emitter and Common Collector Amplifiers; Brief overview of Frequency Response of Common-Emitter Amplifier; MOSFET's; Device Structure and Operation, Current and Voltage Characteristics, MOSFET as Amplifier and Switch; MOSFET Biasing; Small-Signal Operation and Models; Single-Stage MOS Amplifiers; Common Source, Common Gate and Common Drain; Brief overview of High-Frequency Model and Frequency Response of the CS Amplifier; CMOS Digital Logic Inverter; Performance parameters of digital circuits; Introduction to Digital Logic Families; CMOS logic gate circuits, Pseudo NMOS logic circuits, Pass Transistor logic, TTL and ECL circuits, Latches and Flip-flop circuits.

Recommended Texts:

1. S. Sedra and K. C. Smith, *Microelectronic Circuits,* Oxford University Press, 5th Edition 2003.
2. D. L. Schilling and C. Belove, *Electronic Circuits Discrete and Integrated*, Wiley, Tata McGraw-Hill, 3rd Edition, 2005.
3. T. F. Bogart, *Electronic Devices and Circuits*, Prentice Hall, 6th Edition, 2003.

EE-212 ELECTRONIC CIRCUIT DESIGN

Status	C
Credits	3+1
Prerequisite	EE-120

Design of single stage transistor amplifiers considering frequency response caused by internal capacitances, coupling and bypass capacitances; Characteristics of Op-amps circuits and their applications; Output stages for amplifiers: class A, class B, class AB amplifiers; Signal generators: sine, triangular, square wave and pulse train generation using multivibrators, Voltage controlled oscillators, Phase lock loop (PLL) ; Miscellaneous Topics: precision rectifiers, peak detectors, analog switches, sample and hold circuits, Digital to analog and analog to digital converters, voltage regulators, photo electronic devices.

Recommended Texts:

1. S. Sedra and K. C. Smith, Microelectronic Circuits, 7th Ed., Oxford University Press, 2014.
2. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, 3rd Ed., Wiley, Tata McGraw-Hill, 2005.
3. S. Franco, Design With Operational Amplifiers And Analog Integrated Circuit, 3rd Ed., 2002.

EE-213 ELECTRICAL MACHINES

Status	C
Credits	3+0
Prerequisite	PAM-131

Magnetic materials and circuits; Single phase transformers, equivalent circuit, voltage regulation and efficiency; Rotating magnetic field in AC machines; Induced torque; RMS voltage in three phase stators; Introduction to poly-phase synchronous generator; Open circuit & short circuit characteristics, Power angle characteristics; Effect of load changes; Parallel operation; Synchronous Motor principal of operation, Torque-speed characteristics, V-curves, Starting; Induction Motors: Induced Torque, Equivalent circuit, Losses & power flow diagram, Torque-speed characteristics; DC Machinery Fundamentals: Induced voltage, Commutation & armature construction, Armature reaction; Compensating windings, Internal generated voltage & induced torque equation; DC Motors: Motor principal, Torque- Speed characteristics of Series, Shunt & Compound motors; Efficiency calculation; DC Generators and their characteristics; Single phase AC and special purpose motors

Recommended Texts:

4. S. J. Chapman, Electric Machinery Fundamentals, McGraw Hill, 3rd Edition, 2003.
5. E. Fitzgerald, Charles Kingsley, Jr., Stephen D. Umans, Electric Machinery, McGraw Hill, 6th Edition, 2003.
6. E. Hughes, Electrical and Electronics Technology, Pearson, 8th Edition, 2005.
7. Bhag S. Guru, Electric Machinery and Transformers, Oxford University Press, 3rd Edition, 2000.

EE-220 SIGNALS AND SYSTEMS THEORY

Status	C
Credits	3+0
Prerequisite	PAM-260

Basic Discrete-Time and Continuous-Time Signals; System's Properties; Linear Time-Invariant Systems; Convolution; Impulse Response; Frequency Response; Difference Equations; Block diagram and Signal Flow Representation of Constant Coefficient Difference Equations; Fourier Series; Discrete-Time Fourier Series; Continuous-Time Fourier Series; Continuous and Discrete-Time Fourier Transform and its Properties; Sampling Theorem and the Nyquist Rate; Analog-to-Digital (A/D) Conversion; Aliasing; Digital-to-Analog Conversion; Zero-Order and First-Order Hold; Laplace Transform; Transfer Function and System's Block Diagram; Z-Transform; Region of Convergence; Properties; Inverse z-Transform; Solving Difference Equations; Basics of Filters; Examples of Continuous-Time and Discrete-Time Frequency Selective Filters.

Recommended Texts:

1. V. Oppenheim, A. S. Willsky, and S. H. Nawab, *Signals and Systems*, Prentice-Hall, 1997.
2. E. A. Lee and P. Varaiya, *Structure and Interpretation of Signals and Systems*, Addison-Wesley, 2003.
3. Ed. Kamen and B. Heck, *Fundamentals of Signals and Systems Using the Web and MATLAB*, Prentice Hall, 3rd Edition, 2007.
4. C. L. Phillips and J. M. Parr, *Signals, Systems and Transforms*, Prentice Hall, 3rd Edition, 2002

EE-316 INTEGRATED CIRCUITS

Status	**C**
Credits	**3+1**
Prerequisite	**EE-212**

Integrated Circuit Design Methodology; IC Biasing; Current Sources, Current Mirrors and Current-Steering Circuits; High-Frequency Response and General Considerations; CS, CG, CB and CE Amplifiers with Active Loads; High-Frequency Response of CS and CE Amplifiers; Cascade Amplifier; Multistage Amplifiers; MOS Differential Pair, Small-Signal Operation; BJT Differential Pair, Small and Large Signal Operation; Differential Amplifier with Active Load; Frequency Response Multistage Amplifiers; Bipolar Op Amp; Feedback Structure; Negative Feedback; Integrated Operational-Amplifier Analysis; Two-Stage CMOS Op Amp; Common-Mode Range and Output Swing; Folded-Cascade CMOS Op Amp's; 741 Op-Amp Circuit; DC Analysis of the 741; Small-Signal Analysis of the 741. CMOS Digital Logic Inverter; Performance parameters of digital circuits; Introduction to Digital Logic Families; CMOS logic gate circuits; Pseudo NMOS logic circuits, Pass transistor logic, TTL and ECL circuits; Latches and Flip-Flop Circuits; Introduction to VLSI Design.

Recommended Texts:

1. S. Sedra and K. C. Smith, Microelectronic Circuits, 5th Ed., Oxford University Press, 2003.

2. Paul R. Gray, Analysis and Design of Analog Integrated Circuits, 5th Edition, 2009.

EE-224 DIGITAL LOGIC DESIGN

Status	**C**
Credits	**3+1**
Prerequisite	**EE-111**

Number Systems; Conversion between Bases; Negative Numbers; Complements; Binary Coded Decimal Numbers; Octal and Hexadecimal Numbers; Axioms and Theorems of Boolean Algebra; Boolean Functions; Minterm and Maxterm; Logic Gates and IC Digital Logic Families; Karnaugh Map; Combinational Logic; Adders and Subtractors; Design of NAND and NOR Networks; Combinational Logic with MSI/LSI; Comparators; Multiplexers; ROM, PLAs; Latches; Flip-Flops; Synthesis of Sequential Networks; Registers, Counter and Memories; RAM, ROM, PROM and EPROM, Flash Memories; Memory Design; Introduction to FPGA, Verilog HDL; Combinational and Sequential Circuit Design using Verilog; Simulation of Combinational and Sequential using ModelSim; Digital Logic Testing.

Recommended Texts:

1. M. M. Mano, *Digital Design*, Prentice Hall, 3rd Edition, 2001.
2. S. Brown and ,Z. Vranesic, *Fundamentals of Digital Logic with Verilog Design*, McGraw-Hill, 2007.
3. T. L. Floyd, *Digital Fundamentals*, Prentice Hall, 8th Edition, 2003.
4. J. F. Wakerly, *Digital Design: Principles and Practices*, Prentice Hall, 4th Edition, 2006.

EE-226 CIRCUIT ANALYSIS-II

Status	C
Credits	3+1
Prerequisite	EE-111,PAM-260

Response of First-Order RL and RC circuits; Natural and Step response of RLC circuits; circuit analysis using Laplace transform; Frequency selective circuits: Low pass, high pass, band pass, band reject filters; Active filters; Two-port circuits; Fourier Series and Fourier Transform;

Recommended Texts:

1. J. W. Nilsson and S. A. Riedel, *Electric Circuits*, Prentice Hall, 8th Edition, 2008.
2. M. E. V. Valkenburg, *Network Analysis*, Prentice Hall India, 3rd Edition, 2007.
3. J. D. Irwin, *Basic Engineering Circuit Analysis*, Prentice Hall, 7th Edition, 2001.
4. A. H. Robbins and W. C Miller, *Circuit Analysis: Theory and Practice*, 3rd Edition, 2003.

CIS-318 DATA STRUCTURES AND ALGORITHMS

Status	**C**
Credits	**2+1**
Prerequisite	**CIS-101**

Object-based approach, class design and abstract data types; Asymptotic analysis, estimation of the running time of algorithms, best, average and worst case; Sorting algorithms, internal and external sorting; Searching algorithms; Stacks, queues, link lists; Hashing, hash tables, hash function, collisions and their solutions; Trees, traversals, infix, postfix, prefix notations, insertion, search, deletion of nodes, imbalance problem, balanced AVL trees, left and right rotations; Graphs, directed and undirected graphs, graph operations, adjacency matrix and list representations; Algorithm design by examining common problem-solving techniques, divide and conquer approach, greedy algorithms.

Recommended Texts:

1. M. A. Weiss, *Data structures and Algorithms analysis in C++,* Pearson Education, 3rd Edition, 2006.
2. R. Lafore*, SAMS Teach Yourself Data Structures and Algorithms, SAMS, 1999.*
3. T. H. Cormen, C. E. Leiserson and R. L. Rivest, *Introduction to Algorithms,* MIT Press, 3rd Edition, 2009.

ELECTRICAL ENGINEERING CORE (BREADTH)

EE-311 MICROPROCESSORS AND INTERFACING

Status	**C**
Credits	**3+1**
Prerequisite	**EE-112**

Digital computers and their General Architecture; Addressing Modes; Assembly Language Programming and 8086/8088 Instruction Set; Modular Programming; Disk Files; Interrupt Hooks; Clock Generator (8284A); Bus Timing/Buffering and Latching; Minimum Mode vs Maximum Mode; Memory Devices; Address Decoding; 8088 and 80188 Memory Interface; Dynamic Ram; I/O Port Address Decoding; PPI; 8279 Programmable Keyboard/Display Interface; 16550 Programmable Communication Interface; Hardware/ Software Interrupts; 8259A Programmable Interrupt Controller; Arithmetic Coprocessor; Bus Interface; Advanced MP; Introduction to Microcontrollers and their Architecture.

Recommended Texts:

1. B. B. Brey, *The Intel Microprocessors 8086/8088 80186/8018, 80286, 80386, 80486 Pentium and Pentium Pro Processors, Architecture, Programming and Interface*, Prentice Hall, 7th Edition, 2005.
2. A.Singh and W. A. Triebel, *The 8086 and 80286 Microprocessors Hardware, Software and Interfacing*, Prentice- Hall, 1st Edition, 1990.
3. S. Mackenzie, *The 8051 Microcontroller*, Prentice Hall, 4th Edition, 2006.

EE-312 MEASURMENT AND INSTRUMENTATION

Status	**C**
Credits	**3+1**
Prerequisite	**EE-111**

Measurement systems architecture; Statistical Analysis of Errors; Direct Current Meters; Alternating Current Meters; Digital Interfaces in Measurement Systems; Analog Signal Conditioning; Multifunction converters; True RMS to DC Converters; Charge Amplifiers; Phase-sensitive Rectifiers; Sources of Noise , Coherent interference and minimization; Grounding, Shielding, and Supply Considerations; Bridge-Type Instruments; Oscilloscopes; Transducers and their Classification; Various Types of Transducers; Measurement of Displacement, Velocity, Acceleration, Force, Torque, Current, Voltage, Temperature, Flow, Pressure, Level etc.

Recommended Texts:

1. R. B. Northrop, *Introduction to Instrumentation and Measurement*, CRC, 2nd Edition, 2005.
2. L. D. Jones and A. F. Chin, *Electronic Instruments and Measurements,* Prentice-Hall, 2nd Edition, 1991.
3. W. Boyes, *Instrumentation Reference Book*, Butterworth-Heinemann, 3rd Edition, 2002.
4. J. G. Webster, *"The Measurement, Instrumentation and Sensors Handbook"*, Springer, 1st Edition, 1999.

EE-313 ELECTROMAGNETIC THEORY

Status	C
Credits	3+0
Prerequisite	PAM-202

Review of Vector Analysis; Coulomb's Law and Electric Field Intensity; Gauss' Law, Divergence and Electric Flux Density; Energy and Potential; Conductors, Dielectrics and Capacitance; Experimental Mapping Methods; Poisson's and Laplace's Equations; Steady Magnetic Field; Magnetic Forces, Materials, and Inductance; Time-Varying Fields and Maxwell's Equations; Uniform Plane Wave; Plane Waves at Boundaries and in Dispersive Media.

Recommended Texts:

1. W. H. Hayt and J. A. Buck, *Engineering Electromagnetic*, McGraw Hill, 7th Edition, 2005.
2. N. N. Rao, *Elements of Engineering Electromagnetics,* Prentice Hall, 6th Edition, 2004.
3. F. T. Ulaby, *Electromagnetics for Engineers*, Prentice Hall, 1st Edition, 2005.

EE-323 COMMUNICATION SYSTEMS

Status	C
Credits	3+1
Prerequisite	PAM-266, EE-313

Analogue modulation ; Amplitude modulation ; SSB and VSB; Angle modulation; Narrow- and wide-band FM and PM; Frequency division multiplexing; Pulse modulation, PAM and other forms of pulse modulation; Time Division Multiplexing; comparison of TDM and FDM techniques; Digital modulation; Quantization of signals; Quantization errors; Companding; bit and frame synchronization; PCM, DPCM, and Delta modulation; Types of Noise; Noise figure; Signal to noise ratio; Effective noise temperature; Equivalent noise bandwidth; S/N of various modulation systems.

Specific Goals for the Course:

1. To develop the signal processing theory involved in the analysis and design of analog and digital communication systems.
2. To analyze basic analog and digital modulation signals and systems, their bandwidth requirements, and their signal-to-noise ratio performance.
3. To analyze common communication system components, especially mixers and phase-locked loops.
4. To discuss applications to radio, television, cellular telephone, etc.

Recommended Texts:

1. Lathi. B. P., *Modern Analog and Digital Communications Systems*, Oxford University Press, 3rd Edition, 1998.
2. K. G., *Electronic Communication Systems,* McGraw-Hill, 4th Edition, 1992.
3. S. Haykin, *Communication Systems*, Wiley, 4th Edition, 2000.
4. L. W. Couch, *Digital & Analog Communication Systems*, Prentice Hall, 7th edition, 2007.
5. J. G. Proakis and M. Salehi, *Fundamentals of Communication Systems*, Prentice Hall, 2005.

EE-325 ELECTRICAL POWER SYSTEMS

Status	C
Credits	3+0
Prerequisite	EE-223

Sources of electric energy; Load Characteristics an economic aspects; Steam power plants, Hydroelectric power plants; Nuclear power plants; Gas power plants; Transmission line analysis; Insulators for overhead transmission lines; Design of transmission lines; Corona; Insulated cables; Distribution systems; Power substations; Grounding systems; power system protection.

Recommended Texts:

1. S. N. Singh, *Electric Power Generation, Transmission, and Distribution*, Prentice Hall of India, 2003.
2. W. D. Stevenson, *Elements of Power System Analysis*, McGraw Hill, 3rd Edition, 1995.
3. J. Glover and M. Sharma, *Power system Analysis and Design*, PWS Publishers, 1994.
4. M. V. Deshpande, *Switchgear and Protection*, Tata McGraw Hill Co., 1991.

EE-416 LINEAR CONTROL SYSTEMS

Status	C
Credits	3+1
Prerequisite	PAM-256

Examples of Electrical; Mechanical and Biological Control Systems; Open and Closed-loop Control; Mathematical Models; Block Diagrams; Mason's Gain Formula; S-plane System Stability; State Equations; Flow Graphs; Stability; Second Order Systems; Step and Impulse Response; Performance Criteria; Steady State Error; Sensitivity; Analysis and Design with the Root Locus Method; Frequency Domain Analysis; Bode Plots; Nyquist Criterion; Gain and Phase Margins; Nichols Charts; Compensation Techniques; PID and Variants.

Recommended Texts:

1. B. C. Kuo and F. Golnaraghi, *Automatics Control Systems*, John Wiley and Sons, 8th Edition, 2003.
2. K. Ogata, *Modern Control Engineering*, Prentice Hall, 4th Edition, 2001.
3. G. Franklin, J. D. Powelland and A. Emami-Naeini*, Feedback Control of Dynamic Systems,* Prentice Hall, 5th Edition, 2006.
4. N.S. Nise, *Control Systems Engineering*, John Wiley and Sons, 6th Edition, 2010.

ELECTRICAL ENGINEERING (ELECTIVES)

EE-310 ANALOG FILTER DESIGN

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-226

Passive and active realization of first order filters; Second order filters, design parameters and specifications, biquad realizations; Design of Higher Order Filters: Butterworth response, pole locations, and realizations; Chebyshev , inverse Chebyshev, Cauer (elliptic) responses, pole locations, and realizations; Frequency transformations; Delay filters, Bessel-Thomson filters; Delay equalization; LC ladder filters, ladder design, gyrators, negative elements, floating elements; Op-amp oscillators, Wein bridge, RC phase-shift and other oscillators.

Recommended Text:

1. R. Shaumann and R. E. V. Valkanburg, *Design of Analog Filters*, Oxford University Press, 1st Edition, 2001.
2. K. L. Su, *Analog Filters*, Springer, 2nd Edition, 2002.
3. S. Sedra and K. C. Smith, *Microelectronic Circuits ,*Oxford University Press, 5th Edition 2003.

CIS-315 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Status	**ELECTIVE**
Credits	**3+1**
Prerequisite	**NIL**

Introduction, Intelligent Agents, Problem Solving, Solving Problems by Searching, Informed Search and Exploration, Constraint Satisfaction Problems, Adversarial Search, Knowledge and Reasoning, Logical Agents, First-Order Logic, Inference in First-Order Logic, Uncertain Knowledge and Reasoning, Probabilistic Reasoning, Probabilistic Reasoning Over Time, Making Simple Decisions, Making Complex Decisions, Learning from Observations, Knowledge in Learning, Strong-method Problem Solving, Automated Reasoning, Role of Knowledge in Language Understanding, Stochastic Tools for Language Analysis

Recommended Texts:

1. G. F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, , Addison-Wesley, 5th Edition2005.
2. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, Prentice-Hall, 2nd Edition, 2003.

EE-324 POWER GENERATION

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-213

Types of Electrical Loads and Load Survey; Load curves and Load duration Curves; Load factor, Demand Factor, Diversity Factor, Plant use factor, Plant Capacity factor, Load forecasting methods; Tariff Calculations; Power plant cycle; Steam Power Plant; Diesel Engine Power Plants; Gas Turbine Power Plants; Thermal Combine cycle systems and generation; Hydroelectric Power Plants and their main components; Various types of hydroelectric power plants; Types of hydroelectric turbine; Fission reaction and various parts of a typical nuclear power plant; Boiling water, pressurized water, and CANDU type reactors and their parts; Nuclear fuel cycle; Fusion Reactors; Solar photovoltaic; optical effects in semiconductors and PN-junction; analysis and design of converter; solar cells in space; HMD generators; Fuel cells; Wind energy; Geothermal energy; Wave Energy; Tidal Energy; Energy storage; Pollution and Control.

Recommended Texts:

1. M.V. Deshpande, Elements of Electrical Power Station Design, PHI Learning, 2009.
2. G. Boyle, Renewable Energy- Power for a Sustainable Future, OUP Oxford, 2nd Edition, 2004.
3. M. M. El-Wakil, Power Plant Technology, McGraw-Hill Science, 2002.
4. A. J. Wood and B. F. Woolenberg, Power Generation: Operation and Control, John Wiley, 1984.

EE-326 DATA AND COMPUTER COMMUNICATION

Status	ELECTIVE
Credits	3+1
Prerequisite	NIL

Introduction to Data communications, data networks and Internet; OSI model; interconnection components (repeaters, bridges, routers, switches, gateways, hubs); Transmission media, Digital data communication techniques, interfacing to physical layer; Error Control; Flow Control; ARQ Error Control; Switching concepts; Routing and Congestion Control; Multiplexing and Multiple Access; Local Area Networks; Transport Control Mechanisms; Internetwork Protocols; Electronic mail and virtual terminals.

Specific Goals for the Course:

1. To provide students with the understanding of basic building blocks in data and computer communication networks.
2. To familiarize students with the layered architecture involved in building modern computer networks.
3. To provide understanding of various communications topologies, hardware and protocols involved at different layers.
4. To study different approaches of implementing the data communication network and their performance measures.

.*Recommended Texts:*

1. J. F. Kurose and Keith W. Ross, *Computer Networking; A Top Down Approach Featuring the Internet*, Pearson Education, 2nd Edition, 2003.
2. A. S. Tanenbaum, *Computer Networks*, Pearson Education, 4th Edition, 2003.

EE-327 FPGA BASED DESIGN

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-224

Digital System Design Automation with Verilog; Overview of Xilinx ISE Simulator and Synthesizer; Verilog HDL; Elements of Verilog; Verilog Language Concepts; Detailed Data Flow and Behavior Modeling; Always Block; Blocking vs. Non Blocking Assignment; Use of Signed Data; Constructs for Test Bench Development; Finite State Machine with Data Path; Design Examples; Register Transfer Level Combinational Circuits; Regular Sequential Circuits; Synthesis Issues; Pin Assignments; Constraints; IO-Modules; Synthesis and Configuration of UART; PS2 Keyboard; PS2 Mouse; SRAM; VGA Controller Soft Cores; Soft-Microcontrollers; Pico Blaze Microcontroller; Instruction Set; IO Interface; Interrupt Interface; Code Development. Synthesis / Configuration of Pico Blaze Microcontroller.

Recommended Text:

1. P. P. Chu, *FPGA Prototyping By Verilog Examples: Xilinx Spartan-3 Version*, Wiley, 2008
2. S.Palnitkar, *Verilog HDL*, Prentice Hall ,2nd Edition ,2003
3. J. Williams, *Digital VLSI Design with Verilog: A Textbook from Silicon Valley Technical Institute*, Springer, 1st Edition, 2008
4. J. Bhasker, *A Verilog HDL Primer*, Star Galaxy Publishing; 3rd Edition,2005

EE-410 MODERN ELECTRONIC MANUFACTURING PROCESSES

Status	**ELECTIVE**
Credits	**3+1**
Prerequisite	**EE-316**

Introduction to Electronic Components and ICs; Design Approaches; Packaging Types; Bonding Types; Implementation Technology; Reliability; Cost; Volume and Performance Comparison; PCB Design Techniques; Multi Layer Board Design Considerations; Layer Stack up Assignment; Power and Ground Planes; Grounding Methodologies; Image Planes; Layout Consideration; Functional Partitioning; Bypassing and Decoupling; Interconnect and I/Os Considerations; Clock Traces Considerations; Terminations; Trace Routing Considerations; Considerations for Back Planes and Daughter Cards; Noise and EMC Suppression Techniques; Comparison of SMT and through Hole Devices Regarding EMC PCB designing; Using an Electronic CAD Software: Schematic Capture; Layout; Packaging; Routing; Gerber Data Extraction; Pick Place Data Extraction; Printed Circuit Board Technology; Types of PCBs; Fabrication; Image Transfer Considerations; Plating Techniques; Etching Considerations; Electronic Assembly Automation and SMT; Principles of Stencil Design and Printing; Pick and Place Assembly Techniques; CAD and Vision Data Preparation; Principles of Reflow Soldering and Thermal Profiling; Principles of Automatic Optical Inspection (AOI) and AOI Program Generation; Quality and Reliability; Test and Testability; Component Level Testing; System Level Testing; Exhaustive Testing; Fault Grading; Self Testing.

Recommended Texts:

1. M. I. Montose, *Printed Circuit Board Design Techniques,* IEEE Press series, 2000.
2. T. L. Landers, *Electronic Manufacturing Processes,* Prientice Hall, 1994.
3. R. Pursad, *Surface Mount Technology - Principles and Practice,* Springer, 2nd Edition, 1997.

EE-411 POWER ELECTRONICS

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-120

Power Diodes; Series and Parallel Operation; Performance Parameters of Rectifiers; Single Phase Half / Full Wave Rectifiers with Resistive / Inductive Loads; Three Phase Bridge Rectifiers with Restive / Inductive Loads; Power Transistors; Steady State Characteristics; Power MOSFETs; IGBTs; Isolation of Gate and Base Drives; DC-DC Switch Mode Converters; Step Down (Buck); Step up (Boost); Buck-Boost; DC-DC Converters; Converter Comparison; Switch Mode DC-AC Inverters; Single Phase / Three Phase Inverters; Voltage Control of Inverters; Blanking Time; Inverter as Rectifier; Thyristors; Series and Parallel Operation; Firing Circuits; Commutation Techniques; UJTs; Phase Controlled Rectifiers; Single Phase Converters; Three Phase Converters.; AC Voltage Controller; Single Phase Bi-directional Controllers; Three Phase Half / Full Wave Controllers;

Recommended Texts:

1. J. G. Kassakian, M. F. Schlecht, and G. C. Verghese, *Principles of Power Electronics*, Addison-Wesley, 1st Edition, 1991.
2. N. T. Mohan, Undeland, and W. Robbins. *Power Electronics, Converters, Applications, and Design*, John Wiley, 3rd Edition, 2002.
3. M. H. Rashid, *Power Electronics Circuits, Devices and Applications*, Prentice Hall, 3rd Edition, 2003.
4. P. T. Krein, *Elements of Power Electronics*, New York, NY, Oxford University Press, 1st Edition, 1998.

EE-412 TRANSMISSION LINES AND WAVE GUIDES

Status	**ELECTIVE**
Credits	**3+1**
Prerequisite	**EE-220**

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ransmission Line Theory; Lines Types and Characteristic; T-Sections; General Solution of the Transmission Line; Input Impedance; Reflection Coefficient; Wavelength and Velocity of Propagation; Waveform Distortion; Transfer Impedance; Reflection; Reflection Factor and Reflection Loss; Line at Radio Frequencies; Standing Waves, 1/8 and 1/4 Wave Line and Impedance Matching; Half Wave Line; Circle Diagram; Smith Chart; Impedance to Reflection Coefficient and Impedance to Admittance Conversion; Input Impedance of a Lossless Line; Single Stub / Double Stub Matching; Guided Waves; TE and TM Waves and their Characteristics; TEM Waves; Velocities of Propagation; Attenuation of TE and TM Waves; Wave Impedances; Characteristic of TE and TM Waves; Cutoff Wavelength and Phase Velocity; TE / TM Waves in Rectangular Waveguides; Circular Wave Guides and Resonators; Bessel Functions; Solution of Field Equations; TM and TE Waves in Circular Guides; Wave Impedances and Characteristic Impedance; Dominant Mode and Excitation of Modes of Circular Wave Guides; Microwave Cavities; Rectangular Cavity Resonators; Circular Cavity Resonator; Semicircular Cavity Resonator; Q Factor of a Cavity Resonator for TE101 Mode.

Specific Goals for the Course:

Recommended Texts:

1. J. D. Ryder, *Networks, Lines and Field*, PHI, New Delhi, 2nd Edition, 2003.
2. David M. Pozar, *Microwave Engineering*, John Wiley, 3rd Edition, 2004.
3. W. H. Hayt and J. A. Buck, *Engineering Electromagnetic*, McGraw Hill, 7th Edition, 2005.
4. David K.Cheng, *Field and Waves in Electromagnetism*, Pearson Education, 1st Edition, 1989.

EE-414 DIGITAL SIGNAL PROCESSING

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-323

Discrete-Time Signals and Systems, Linear Time Invariant Systems, Z-Transform and it's Properties, Transform Domain Representation of Signals and Systems; Discrete-Time Fourier Transform (DTFT); Discrete Fourier Series; DFT and its Properties; Computation of DFT; Fast Fourier Transform (FFT); Linear Convolution Using DFT; Structures for Discrete Time Systems; IIR Systems; FIR Systems; Effects of Coefficient Quantization; Effect of Round-off Noise in Digital Filters; Zero-input Limit Cycles; Filter Design Techniques; Linear Phase Filtering; Design of FIR Filters by Windowing; Optimal FIR Filter Design; IIR Filter Design Transformations; Sampling and Multirate Digital Signal Processing; Changing the Sampling Rate using Discrete-Time Processing; Digital Signal Processors; Algorithms and their Implementation in Digital Signal Processors.

Recommended Texts:

1. A. V. Oppenheim, R. W. Schafer, and J. R. Buck, *Discrete-Time Signal Processing*, Prentice Hall, 3rd Edition, 2009.
2. S. K. Mitra, Digital Signal Processing: *A Computer-Based Approach*, McGraw Hill, 2nd Edition, 2001.
3. J. G. Proakis, and Dimitris G. Manolakis*, Digital Signal Processing: Principles, Algorithms, and Applications,* Prentice Hall, International Edition, 2007.

EE-415 POWER SYSTEMS ANALYSIS

Status	**ELECTIVE**
Credits	**3+1**
Prerequisite	**EE-223**

Overview; Voltages, currents and power in three-phase circuits; Generators, Power Transformers, and their equivalent models; Per unit quantities; Series impedance of transmission line; Capacitance of Transmission lines; Representation of short, medium, and long transmission lines; Power flow analysis; Admittance models, impedance models and network calculations; Power flow analysis; Symmetric faults; Symmetric components; Sequence networks; Unsymmetrical faults; Economic operation of power systems; Power system stability.

Recommended Texts:

1. J. D. Glover,M. S. Sarma and, T. Overbye, Power System Analysis and Design, Cengage Learning, 5th Edition, 2011.
2. H. Saadat, Power System Analysis, McGraw-Hil, 2002.
3. J. Grainger andW. Stevenson Jr., Power System Analysis, McGraw-Hill Science, 1994.
4. William Stallings, *Data and Computer Communication*, Prentice-Hall, 7th Edition, 2004.

EE-418 POWER TRANSMISSION, DISTRIBUTION AND UTILIZATION

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-415

Overview of transmission Line parameters and representation; Mechanical Design of Overhead Lines; Corona; Auto transformer; Three Phase Transformers: Star/Star, Delta/star connection, Open-Delta & Scott connection, Power supplied by V-V bank; Three phase to two phase conversion & vice versa; Underground Cables; HVDC Transmission; radial, ring main, overhead and underground systems; Introduction to underground cables; Mechanical design of transmission lines; Insulator material and their types; Voltage distribution over insulator string; Methods of improving the string efficiency; Testing of insulators; High voltage dc overhead transmission lines; Insulated electrical cables; Determination of faults in underground cables; Introduction to distribution system; Urban, suburban and rural distribution systems; Primary, Radial and ring main systems; Application of distribution transformers, Estimation of load and load characteristics; Substation switch gears and bus bar arrangements; Calculation of voltage drop and regulation in distribution feeders; Grounding and earthing; Distribution transformer neutral, earthing resistance, earthing practice in L.V. networks; Calculation of voltage drop and regulation in distribution feeders; Power factor correction; Synchronous condensers; Selection of different drives in an industry; Electric traction; Electric heating; Induction and dielectric heating; Electric welding; Different lighting schemes for industries, roads, railways, wards, airports and stadiums

.Recommended Texts:

1. T. Gonen, Electrical Power Distribution System Engineering, CRC Press; 2nd Edition, 2007.
2. T. Gonen, Electrical Power Transmission System Engineering: Analysis and Design, CRC Press, 2nd Edition, 2009.

EE-419 ELECTRIC MACHINE DESIGN

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-223

Windings of electrical machines: Basic principles; phase windings; base windings; fractional slot windings; commutator windings; rotor windings of asynchronous machines. Design of magnetic circuits: Magnetic voltage of a tooth and a salient pole; magnetic voltage of a stator and rotor yokes, magnetic materials of a rotating machine; permanent magnets in rotating machines; calculation of flux leakage; influence of skin effect on resistance. Main dimensions of a rotating machine: Mechanical, electrical and magnetic loadability. Design process: Asynchronous motor; synchronous machine; DC machines. Insulation of Electrical machines: Dimensioning and insulation; practical insulation constructions; Heat transfer: Losses; heat removal, thermal equivalent circuit.Transformers: Single phase and three phase transformers; choice of specific loadings; expression for volts/turn; determination of main dimensions of the core; types of windings and estimation of number of turns and conductor cross sectional area of primary and secondary windings, estimation of no load current, expression for leakage reactance and voltage regulation.

Recommended Texts:

1. J. Pyrhön, T. Jokinen and V. Hrabovcová,Design of Rotating Electrical Machines, John Wiley and Sons, 2008.
2. A. K. Sawhney, Electrical Machine Design, DhanpatRai& Co., 2013.
3. M.V. Deshpande, Design and Testing of Electrical Machines, PHI learning, 2010.
4. IndrajitDasgupta, Design of Transformers, Tata McGraw Hill, 2010.
5. K. M. Vishnu Murthy, Computer Aided Design of Electrical Machines, BS publications, 2008.

EE-420 ELECTRICAL MOTOR DRIVES

Status	**ELECTIVE**
Credits	**3+1**
Prerequisite	**EE-411**

Introduction to Drives: Types, Criteria for Selection, Classification, Load Profiles and Variable Speed Topologies; DC Motor Drives: Equivalent Circuit, Permanent & Separately Excited Motors, Armature Current Wave Forms, Types of Power Actuators, Actuator Characteristics, DC Servo Drives, Variable Speed DC Drives; Induction Motor Drives: Introduction & Basic Principle, Induction Machine Characteristic, Speed Control by Stator Frequency and Voltage, Impact of non sinusoidal excitation, Variable Frequency Power Converters requirements and characteristics, Variable Frequency PWM-VSI Drives, Variable Frequency Square Wave Drives, Variable Frequency Current Source Drives, Comparison of Drives, Line Frequency Variable Voltage Drives, Soft Starting, Slip Control Drive. Synchronous Motor Drives: Introduction & Basic Operation, Synchronous Motor Drive with Sinusoidal Waveforms, Synchronous Motor Drive with Non-Sinusoidal Waveforms, Load Commutated Inverter Drives, Cycloconverters. Special Motor Drives: Stepper Motor Drives, Switched Reluctance Motor Drive, Synchronous Reluctance Motor Drive.

Recommended Texts:

1. N. Mohan, *Power Electronics Converter Application and Design*, Wiley and Sons, 2nd Edition 2003.
2. M. Rashid: *Power Electronics Circuits Devices and Application*, Prentice Hall, 7th Edition, 2009.

EE-421 ANTENNA THEORY AND DESIGN

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-412

Plane Wave Propagation in Free Space; Aperture Antenna; Point-point Transmission and Point-area Transmission; Obstacle Effects; Received Signal Strength; Atmospheric Effects; Antenna Fundamentals and Definitions: Radiation Mechanism; Maxwell's Equations; Ideal Dipole; Radiation Patterns; Directivity and Gain; Antenna Impedance; Radiation Efficiency; Antenna Polarization; Resonant Antennas: Dipole Antennas; Yagi–uda Antennas; Micro Strip Antenna; Arrays; Array factor; Pattern Multiplication; Directivity; Mutual Coupling; Phased Arrays; Feeding Techniques; Broad Band Antennas and its Types; Aperture Antennas and its Types; Gain Calculations for Reflector Antennas; Field Representations; Feed Antennas; Antenna Synthesis Problem and Solution Methods; Method of Moments; CEM for Antennas: Ray Fixed Coordinate System; E-plane Analysis of Horn Antennas; Cylindrical Parabolic Antenna; Radiation on a Finite Ground Plane; Equivalent Current Concepts; Multiple Diffraction Formulation by Curved Surfaces; Method of Stationary Phase; Cylindrical Parabolic Reflector Antennas.

Recommended Texts:

1. W. L. Stutzman and G. A. Thiele, *Antenna Theory and Design*, John Wiley and Sons Inc, 2nd Edition, 1997.
2. C. A. Balanis, *Antenna Theory Analysis and Design*, Wiley-Interscience, 3rd Edition, 2005.
3. J. D. Kraus, *Antennas*, McGraw Hill, TMH, 3rd Edition, 2003.
4. C. Haslett, *Essentials of Radio Wave Propagation,* Cambridge University Press, 1st Edition, 2008.

EE-422 VLSI DESIGN

Status	**ELECTIVE**
Credits	**3+1**
Prerequisite	**EE-316**

CMOS Basics; CMOS Technology; Diode and MOSFET Transistors; MOSFET Switches; Transmission Gate; Inverter DC/AC Analysis; Combinational Logic; Sequential Logic; VLSI Design Methodologies: Diagrams Layout; Tools-MAGIC IRSIM; Synopsys; Types of ASICs; Package Types; Memory; I/O Cells Selection; Transmission Lines; Interconnects Effects; Timing Analysis; Digital Design Review; Setup; Hold Times; Clock Skew; Design Tradeoffs; Designing for Speed; Power; Reliability; Testability; Power Analysis; Area and Power Dissipation Estimation; Simultaneously Switching Outputs; VDD/VSS Pairs; Ground Bounce; Latch up; Meta-stability Design for Testability; Fault Tolerance; Design Flow; Design Specifications; ASIC Design Flow; Schematic Entry; HDL; Synthesis; Design Guidelines; Design Rule Checking; Hierarchical Layout Methodology; Design Verification; Static Timing Analysis; Functional Simulation; Timing Simulation; Formal Verification ;Testing on Proto-boards.

Recommended Texts:

1. N. Weste and D. Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, Addison Wesley, 3rd Edition, 2005.
2. R. J. Baker, *CMOS Circuit Design, Layout, and Simulation*, Revised 2nd Edition , 2007

EE-423 DIGITAL CONTROL SYSTEMS

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-416

Quantization; Sample and Hold; Z-transform and Inverse Z-transform; Solving Difference Equations; Z-Plane Analysis of Discrete-Time Control Systems; Convolution Integral and Z-transform; Sampling Theorem; Sampling Rate Selection; Reconstruction; Pulse Transfer Function; Realization of Digital Controllers; Mapping between S-plane and Z-plane; Design by Emulation; Root Locus and Frequency Domain Analysis; Transient and Steady-state Response Analysis; Root-Locus Design; Frequency-domain Design; Analytical Design Method; State-Space Analysis; State Space Representation; State Equations and their Solution; Discretization of Continuous State-space Equations; Deadbeat Control.

Recommended Texts:

1. K. Ogata, *Discrete-Time Control Systems*, Prentice Hall, 2nd Edition, 1995.
2. J. R. Leigh, *Applied Digital Control*, Dover Publications, 2nd Edition, 2006.
3. K. J. Astrom, *Computer-Controlled Systems*, Prentice Hall, 3rd Edition, 1996.

EE-424 COMPUTER SYSTEM ARCHITECTURE

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-311

Introduction to Computer Architecture; The Von Neumann Model, The System Bus Model, and Computer Structures, Accumulator-Based Machines, Stack Machines; Computer instruction Set, op-code encoding, Addressing Modes, Instruction Types; Introduction to CPU, Register Section Design, Adders/subtractors, ALU Design, Multiplication Unsigned and Signed Integers ,Division of Unsigned Integers , Floating Point Arithmetic; Co-processor, Introduction to Control unit; Basic Concepts: Register Transfers,CPU Buses Organization, Generation of timing Signals, One Hot Method and Classical Method; Design methods: Hardwired Approach, Micro programmed Approach, Design of a Micro programmed CPU; Introduction to Memory, Characteristics of Memory Systems, Main Memory Design, Memory Hierarchy, Cache Memory,Virtual Memory; Parallel Bus Architectures; Bridge-Based Bus Architectures; Internal Communication Methodologies; Serial Bus Architectures; Mass Storage: RAID – Redundant Arrays of Inexpensive Disks; Input Devices; Output Devices; Parallel Architecture; Superscalar Machines and the PowerPC; VLIW Machines; Unconventional Architectures.

Recommended Texts:

1. D. A. Patterson and J. L. Hennessy, *Computer Architecture: A Quantitative Approach*, Morgan Kaufmann, 4th Edition, 2007.
2. W. Stallings, *Computer Organization and Architecture– Designing for Performance*, 9th Edition, 2007.
3. M. Abd-El-Barr and H. El-Rewini, *Fundamentals of Computer Organization and Architecture*, John Wiley and Sons, 1st Edition, 2005.
4. J. P. Hayes, *Computer Architecture and Organization*, McGraw HILL, 3rd Edition, 1998.

EE-425 FUNDAMENTALS OF ROBOTICS

Status	ELECTIVE
Credits	3+1
Prerequisite	PAM-242

Kinematics; Dynamics; State variable representation and linearization of nonlinear models; motion planning, motion control, trajectory planning; mechanisms and actuation; Sensors; Robotic system architecture and programming; mobile robotics, types and classification, localization and mapping; kinematically redundant manipulators, parallel mechanisms; robots with flexible joints; Programming in player/stage simulator; case studies: PUMA560, RHINO XR3, SCARA, STANDFORD ARM.

Recommended Texts:

1. J. Craig, *Introduction to Robotics: Mechanics and Control*, Prentice Hall, 3rd Edition, 2004.
2. B. Siciliano, and O. Khatib (Eds.), *Handbook of Robotics,* Springer, 2008.
3. R. J. Schilling, *Fundamentals of Robotics: Analysis and Control*, Prentice Hall, 2007.

EE-426 INDUSTRIAL AUTOMATION

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-416

Introduction to Programmable Logic Controllers; Ladder Logic programming, PLC connections, Ladder Logic Inputs and Outputs, PLC Hardware; Input and Output Modules, Relays, Logical Sensors, Sensor wiring, Presence detection of Contact Switches, Reed Switches, Optical Sensors, Capacitive Sensors, Logical Actuators, Solenoids, Valves, Hydraulic and Pneumatic Actuators, Motors. Boolean Logic Design details; PLCs Operation, Latches Timers, Counters. Structured Logic Design. State Based Design; Handling numbers and data; Using PLC memory bits; Data handling using ladder logic functions; Structured Text Programming; Function Block Programming; Analog Inputs and Outputs, Continuous Control, PID Control, Serial Communication, Networking, Human Machine Interface (HMI), SCADA and its use.

Recommended Texts:

1. W. Bolton, *Programmable Logic Controllers: Newnes*, Elsvier, 2009.
2. H. Jack, *Automating Manufacturing Systems*, Springer, 2010.
3. K. Collins, *PLC Programming for Industrial Automation*, 2009.
4. PLC Manufacturers Material in PDF (e.g., Siemens), Latest available.

EE-427 DIGITAL COMMUNICATION SYSTEMS

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-323

Digital bandpass modulation; Memory less modulation methods; Digital signalling scheme with memory; Detection of signals in Gaussian noise; Coherent Detection; Non-coherent detection; Error performance of Binary systems; Communication Link Analysis; Characterization of bandlimited channels, Signal Design for band limited channels; Optimum receivers for channels with ISI and AWGN; Linear equalizer; Introduction to Information theory; Linear Block codes; Error Detecting and correcting capability; Cyclic codes; Convolution coding.

Specific Goals for the Course:

To familiarize students with the fundamental structure and concepts involved in the analysis/ design of digital communication systems such as Cellular, satellite communications, and wireless data networks. Specific objectives are

1. To provide understanding of digital modulation techniques their BER performance.
2. To learn signal conditioning methods for band limited channels.
3. To learn concepts of information theory, and its applications in various coding processes to improve performance in terms of BER

.*Recommended Texts:*

1. J. G. Porakis and M. Salehi, *Digital Communications*, Mc Graw Hill, 5th Edition,
2. M. K. Simon and S. Alouini, *Digital Communication over Fading channels*, John-Wiley and Sons 2nd Edition,.
3. B. Sklar, *Digital Communications; Fundamentals and Applications*, Prentice Hall, 2nd Edition.

EE-428 RENEWABLE ENERGY SYSTEMS

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-223

Electrical Power Industry; Distributed Generation; Economics of Distributed Resources; Wind Power Systems: Solar Resources; Photovoltaic Materials and Electrical Characteristics; Photovoltaic Systems; Ocean Energy; Geothermal Energy; Fuel Cell; Biomass and Biofuel; Introduction to Smart Grids; Smart Grid and Integration Renewable Energies

Recommended Texts:

1. G. M. Masters, *Renewable and Efficient Electric Power Systems,* Wiley, 2004.
2. A. V. da Rosa, *Fundamentals of Renewable Energy Processes*, Academic Press, 2005.
3. E. F. Fuchs and M. A. S. Masoum, *Power Conversion of Renewable Energy Systems*, Springer, 2011.

EE-429 WIRELESS AND MOBILE COMMUNICATION

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-323

Overview of wireless communication; Wireless spectrum and its limitations; Radio wave propagation; Transmit and Receive signal models; Ray tracing models, Empirical path loss models; Statistical Description of a wireless channel; Narrow band fading models; Wideband fading models; Discrete time models; Space-time Channel models; Capacity in AWGN; Capacity of flat-fading and frequency selective fading channels; Optimum Receivers for fading channels; Performance of Single and Multichannel receivers; Diversity principle; Micro and Macro diversity; Multiple channel and Advanced Transceiver Schemes; Frequency and Time Division Multiple Access Systems; Principle of Cellular Networks; Spread Spectrum Systems; Orthogonal Frequency Division Multiplexing; Overview of standardized Wireless Systems; GSM IS-95, CDMA 2000, WCDMA/UMTS, 3GPP Long-Term Evolution, WiMAX and WLAN.

Recommended Texts:

1. A. Goldmith, *Wireless Communications*, Cambridge University Press, 2005.
2. M. K. Simon and M. S Alouini, *Digital Communication Over Fading Channels*, Wiley-Interescience, 2nd Edition. 2005.
3. A. F. Molisch, *Wireless Communications*, John Wiley and Sons Ltd., 2nd, Edition. 2011.

EE-430 HIGH VOLTAGE ENGINEERING

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-312

Dielectrics in electrical equipment; Insulator properties; Dielectrics in combination; Selection criteria; electric breakdown in gases; Townsend theory; space-charge; streamer mechanism; Breakdown in uniform and non-uniform fields; Compressed gases and vacuum; Surge breakdown; Time-lag; Corona and lightning discharges; Breakdown in solid and liquid dielectrics, intrinsic, electromechanical, streamer, thermal and corrosion breakdowns; Flashover along contaminated surface; Treeing; breakdown in pure and commercial liquids; Generation of high alternating voltage; Transient and direct voltage measurement; electrostatic voltmeter; Sphere-gap; Uniform field gap; Ammeter; Insulation testing; Resistivity; permittivity; Dielectric loss; Discharge; Radio interference; Transients; Simple switching; Circuit closing; Recovery and lightning transient; Protection against over-voltage; Line shielding; Ground practice; Impulse voltage distribution on transformer windings; Equalization of voltage distribution; Insulation coordination; Electric field mapping.

Recommended Texts:

1. E. Kuffel, W. S. Zaengl andJ. Kuffel, High Voltage Engineering: Fundamentals, Newnes, 2nd Edition, 2000.
2. M S Naidum, High Voltage Engineering, Tata McGraw Hill Education Private Limited, 4the Edition, 2010.

EE-431 POWER SYSTEMS OPERATIONS AND CONTROL

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-415

Steady state and transient stability problems of multi-machine interconnectedsystems, Swing equation, point-by-point solution of swing equation.Equal area criterion, One machine and two-machine systems, Critical fault clearing time.Effect of fault on stability, Stability study of typical Power systems.Introduction to power system control and its importance, modes of power system operation, major tasks of operation.SCADA system, control centers, controller tuning, communication sub system, remote terminal unit, data logging.Economic dispatch, characteristics of power generation units, economic dispatch problemswith and without consideration of losses, incremental fuel cost, penalty factor,economic power interchange.Voltage, power and frequency control.Evaluation of the effect of speed change on droop characteristics.

Recommended Texts:

1. P. Kundur, Power System Stability and Control,1994.
2. W.Barg, Power Generation, Operation and Control, 1996.
3. L. L. Grigsby,Power System Stability and Control, Electric Power Engineering 2012
4. T. Cegrell, Power Systems Control Technology, Prentice-Hall International Series in Systems and Control Engineering, 1986.

EE-432 POWER SYSTEM PROTECTION

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-418

Introduction; Faults and abnormal operating conditions, types of faults, evolution of power systems, protection system and its attributes, power system transducer, Various power system elements which need protection, principle of power system protection,Over current protection of transmission lines: Fuses, thermal relays, over-current relay, protection of three phase feeder, directional over current relay, Drawback of over current relay,Differential Protection: Dot marking, simple differential protection, zone of protection of differential relay, percentage differential relay earth leakage protection, Transformer protection: Types of transformer, Types of faults in transformer, over current protection, differential protection relay, Busbar protection: Differential protection of busbar, Selection of CT ratio-wrong method and correct method, external and internal faults, actual behavior of a protective CT, supervisory relay, protection of three phase busbars,Distance protection of transmission lines: Drawback of Over-current protection, simple impedance relay, reactance relay, Mho relay, comparison among distance relays, distance protection of three-phase relays,Induction motor protection, Static comparators as relays, Numerical protection, carrier aided protection of transmission lines, generator protection.

Recommended Texts:

1. Y. G. PaithankerandBhide, Fundamentals of Power System Protection, Prentice Hall, 2010
2. S. S. Rao, Switchgear and Protection, Khann Publishers, 1983.
3. M. V. Deshpande, Switchgear and Protection, Tata McGraw Hill Co., 1991.
4. S. H Horowitz and A. G. Phadk, Power System Relaying, John Wiley, 1992.

EE-433 POWER SYSTEM QUALITY

Status	ELECTIVE
Credits	3+1
Prerequisite	EE-415

Power System Quality, Issues, and Standards; Voltage Sages and Interruptions; Power System Transient Models; Transients their Causes and Types; Power Frequency Disturbances; Harmonics; Effect of Harmonics on Power System Devices; Long Duration Voltage Variations; Wiring and Grounding; Power Factor Correction and advantages; Electromagnetic Interference; Static Electricity; Measuring an Solving Power Quality Problems.

Recommended Texts:

1. R. C. Dugan, M. F. McGranaghan and S. Santoso and H. W. Beaty, *Electrical Power Systems Quality*, McGraw-Hill Professional; 3rd Edition, 2012.
2. C. Sankaran, *Power Quality*, CRC Press, 2001.

INTER-DISCIPLINARY ENGINEEERING

ME-122 WORKSHOP PRACTICE

Status	C
Credits	0+1
Prerequisite	Nil

Fitter Shop. Assembly/disassembly of basic mechanical components, e.g. bearings, keys, belts, etc. Basic Processes in Wood Work Shop. Timber, its defects and preservation methods, different types of wood joints, making a small wooden model. Basics of Electric Shop. Types and uses of cables. Study of household electrical appliances. Functions of Forge & Foundry Shop. Brief introduction, tools and accessories, furnace types, heat treatment furnaces. Carbon dioxide casting. Machine Shop. Introduction to machine tools, basic lathe operations including turning, facing, screw cutting. Welding. Introduction to soldering, brazing and welding, brief details of gas, and electric arc welding. Students will be assigned practical jobs in machine shop, electrical shop, fitting shop, carpentry shop and smithy shop.

Recommended Texts:

1. W. A. J. Chapman, *Workshop Technology Part-I*, Butterworth-Heinemann, 5th Edition, 1972.
2. H. P. Schwan, *Electrical Wiring*, McGraw Hill, 1982.
3. *Wiring Manual*, Pak Cables Limited.

ME-196 ENGINEERING DRAWING

Status	C
Credits	0+1
Prerequisite	Nil

Type of lines and usage, dimensioning, lettering, orthographic first angle projection, sheet planning, orthographic third angle projection, introduction to computer-aided drawing, isometric projection, sectional drawing and assembly drawing. Drawing sheets will be prepared on drawing board as well as CAD package.

Recommended Texts:

1. A. C. Parkinson, *First Year Engineering Drawing*, Pitman & Co., 1961.
2. Creo University Plus (formerly Pro/Engineer) Design Software Documentation, PTC®, 2012.

ME-198 ENGINEERING MECHANICS

Status	C
Credits	2+1
Prerequisite	Nil

Fundamental Concepts and Principles of Mechanics; Resultant Forces and Couples; Laws of Equilibrium, Free Body Diagrams; Fundamentals of Dynamics of Particle and Rigid Body; Kinematics of Particles; Rectilinear Motion; Principle of Work and Energy; Linear Impulse Momentum Principle.

Recommended Texts:

1. R. C. Hibbler, *Engineering Mechanics*, Prentice Hall, 12th Edition, 2009.
2. J. L. Meriam and L.G. Kraige, *Engineering Mechanics,* Wiley, 6th Edition, 2006.

ME-199 APPLIED THERMODYNAMICS

Status	C
Credits	3+0
Prerequisite	Nil

State Property; First and Second law of Thermodynamics; Internal Energy; Perfect Gases and Laws; Specific Heat; Properties of Vapor; P-V Diagrams; Entropy; Carnot's Cycle; Reversibility; Enthalpy; Types of Internal Combustion Engines; Refrigeration and Air-conditioning; Steam and Gas Turbines.

Recommended Texts:

1. Y. A. Cengel and M. A. Boles, *Thermodynamics, An Engineering Approach*, McGraw Hill, 2007.
2. M. Michael, *Fundamentals of Thermodynamics*, Wiley, 5th Edition, 2003.
3. V. Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, John Wiley and Sons, 3rd Edition, 1985.

NE-404 BASIC NUCLEAR ENGINEERING

Status	**Elective**
Credits	**3+0**
Prerequisite	**PAM-131**

Natural and Artificial Radioactivity; Radioactive Decay; Half Life; α, β and γ Decay Mechanisms; Nuclear Reactions; Fission; Fusion; Role and Importance of Nuclear Energy; Nuclear Cross Sections; Reaction Rates; Nuclear Fission and Chain Reaction; Reactor Control Requirements; Criticality Conditions; Conversion and Breeding; Reactor Components and Their Characteristics; Classification and Design Features of Research, Production, and Power Reactors; Introduction to Fast and Fusion Reactor Systems; Different Types of Nuclear Fuel Cycles; Front End and Back End Fuel Cycle Operations; Fuel Burn-up; In-core Fuel Management Principles; Radiation Units; Radiation Sources; Biological Effects of Radiation; Radiation Protection Standards; Radiation Dose Calculations; Radiation Shielding; Radiation Protection Principles; Safety Aspects of Nuclear Power Plants.

Recommended Texts:

J. K. Shultis and R. E. Faw, *Fundamentals of Nuclear Science and Engineering*, CRC Press, 2nd Edition, 2008.

1. J. R. Lamarsh and A. J. Baratta, *Introduction to Nuclear Engineering*, Prentice Hall, Inc., 3rd Edition, 2001.
2. S. Glasstone and A. Sesonske, *Nuclear Reactor Engineering*, Chapman and Hall, Inc., 4th Edition, 1991.

SENIOR PROJECT DESIGN

EE-499 THESIS PROJECT

Status	**C**
Credits	**0+6**
Prerequisite	**The student should pass 70% of the Credit Hours course work.**

Students are required to select a design project. The project can be to solve a problem being faced in industry or it may be oriented towards designing a product. The project can also be motivated from a research problem taken from literature. At the end of 7th semester, students will have to submit a preliminary report of the project and have to clear a viva voce examination.

The remaining credit hours of work started in 7th semester should be completed in the 8th semester followed by submission of the project report and viva voce.

Recommended Text:

1. As advised by the Project Supervisor.