Green University of Bangladesh

Department of Electrical and Electronic Engineering

Syllabus of
B. Sc. in Electrical and Electronic Engineering

(To be enacted from Summer 2018, 25th Academic Council Meeting, 29.01.2018**)**

Bachelor of Science in Electrical and Electronic Engineering (EEE)

The exponential growth of Electrical and Electronic devices and their applications across the world has created a vast demand of high quality graduates in Electrical and Electronic Engineering (EEE). It is an ever-growing field, and a Bachelor degree in EEE brings an amazing range of prospects for the students. We have designed syllabus for our Bachelor of Electrical and Electronic Engineering (B. Sc. in EEE) degree to meet the specific needs and desired career goals of our students. Our graduates are expected to earn sufficient competencies both in technical and general areas required for quality employment in industries and academia at home and abroad.

Preface

EEE Syllabus was approved by UGC in 27.07.2008. In the 1st Meeting of EEE Curriculum Committee held on 2nd May, 2015, EEE 451 (Green Communication) and EEE 459 (Green Computing) have been incorporated in the syllabus. It was decided that EEE 201 (Electronics I', EEE 209 (Electronics II), EEE 210 (Electrical and Electronic Circuit Simulation Laboratory) and EEE 314 (Electronics Laboratory) courses should be offered to the students sequentially in Level II, Term I, II, III and Level III, Term I respectively. It was also decided to include 'HUM 401 (Financial and Managerial Accounting). To accommodate the course offering, one of the Humanities group courses shall be offered to the students in Level II, Term III instead of Level II, Term II. A new laboratory course was included in the proposed new curriculum of EEE Department named as 'EEE 324 Power System Laboratory'. EEE Department of GUB will provide maximum 13.5 credits waiver to Diploma students

admitted in B.Sc Engg. in EEE (Evening) program based on the requirement that the syllabus matches at least 80%.

The 2nd Meeting of EEE Curriculum Committee was held on 13th August, 2015. Some decisions were taken. 'Green Power and Energy' and 'Green Computing' courses as revised by Prof. Dr. Md. Quamrul Ahsan as well as 'Green Communications' and 'Green Electronics' courses as revised by Prof. Dr. Mohammad Shah Alam have been incorporated in EEE Curriculum as Elective Courses. Bundle of the Humanities Course Group of EEE Curriculum was broken down and the students could take any three courses from HUM 201, 203, 205 207, 209 and 401. MGT 4201(Business communications) course was renamed as Hum 301 (Business Communication). "EEE 311 Numerical Methods" course was shifted to the core course group from the inter-disciplinary course group since there is a laboratory course named "EEE 404 Numerical Technique Laboratory" in the core course group based on the topics of EEE 311 course. Besides, a new inter-disciplinary course "CE 201 Introduction to Civil Engineering" was included. "EEE 313 Biomedical Instrumentation" course was renamed as "EEE 313 Biomedical Engineering" and a new laboratory course named "EEE 314 Biomedical Engineering Laboratory" based on theory course "EEE 313 Biomedical Engineering" was also incorporated in the inter-disciplinary course group. "CSE 101 Computer Programming" and "CSE 102 Computer Programming Laboratory" courses were shifted from the core course (CSE) group to the core course (EEE) group. "ME 201 Mechanical Engineering Fundamentals" course was shifted from the core course (ME) group to the inter-disciplinary course group. "EEE 311 Numerical Methods" course should be in the core course group and recoded and renamed as "EEE 403 Numerical Techniques". Two other courses named "EEE 311 Robotics and Automation" and "EEE 312 Robotics and Automation Laboratory" was included in the inter-disciplinary course group. "EEE 316

Measurement and Instrumentation Laboratory" based on theory course "EEE 315 Measurement and Instrumentation" and "CE 201 Introduction to Civil Engineering were also included in the inter-disciplinary course group. The syllabus of the three (3) English Language courses named "EAP 009 English for Academic Purposes" with 0 credit, "EAP 101 English for Academic Purposes I" with 3 credits and "EAP 102 English for Academic Purposes II" with 3 credits were unanimously approved. The syllabus of the new course named "GED 201 Bangladesh Studies" with 3 credits was unanimously approved and was included in the "Humanities Course Group" with the effect from Fall 2015 Semester. The syllabus of the "PSD 400 Professional Life Skills Development" course with zero (0) credit was approved and was included as the "Professional Course" Group. "EEE 461 Satellite Communication", "EEE 463 Broadcast Engineering", "EEE 465 Radio and Television Engineering", "EEE 467 Optical Networks" and "EEE 469 Radar and Navigation"; in Electronics Course Group, "EEE 436 Optoelectronics Laboratory", "EEE 471 Nano Electronic Devices", "EEE 472 Nano Electronic Devices Laboratory", "EEE 473 Hardware Design with VHDL" and "EEE 474 Hardware Design with VHDL Laboratory"; in Power Course Group "EEE 475 Power System Economics" and "EEE 477 Nuclear Power Engineering" and in Computer Course Group "EEE 479 Cryptography and Network Security" were included.

The third curriculum committee meeting was held on 9.6.2016. The total credits were reduced from 147 to 144. To accommodate this the total credit hours for Elective courses was reduced from 24 credits to 21 credits (15 credits from Major group and 6 credits from Minor group). A new course entitled as – 'Electrical Waste Management' and course code EEE 461 was included

The 4th curriculum committee meeting was held on 11.04.2017. It was decided to change the Mission and Vision of the department. The

content of the syllabi of the courses like EEE 207, EEE 301, EEE 405, EEE 401, EEE 321, EEE 455, EEE 461 were modified.

The 5th curriculum committee meeting was held on 10th November 2017. As per UGC requirement Language and General Education requires 15%, Basic Science and Mathematics 20%, other Engineering 5% and Program Courses 50%. To accommodate this HUM 211 (Functional Bengali Language), HUM 213 (Bangladesh Studies: history of Independence, EAP 204 (English Lab), HUM 205 (Engineering Economics) and HUM 403 (Ethics and Environmental Protection) were included in the syllabus. MATH 301 (Numerical Methods) were included in Mathematics group. EEE 481: Electrical Properties of Materials were shifted to elective group. To accommodate total credit the course EEE 210: Electrical & Electronic Circuit Simulation Lab was omitted from the syllabus.

Vision Statement

The vision of the Department of Electrical and Electronic Engineering, Green University of Bangladesh (GUB) is to develop it as a full-fledged learning and research hub of Bangladesh within next fifteen years and hence to make positive contribution towards technical and socio-economical development of the country.

Mission Statement

The Mission of the Department of Electrical and Electronic Engineering is to produce graduates who

- Can understand the basic concept of modern electrical and electronic technology.
- Will be prepared towards research, entrepreneurship and lifelong learning in the field of EEE.
- Will be able to apply their knowledge in solving the technical problems with leadership skill.

- Will create environment of learning with due consideration of ethical and moral issues.
- Will provide knowledge based technology and service to meet the needs of the society.

Goals of the Department

The goals of the Department of Electrical and Electronic Engineering are to:

a) Prepare the students for entry into the profession;
b) Instill in students the capabilities required by the discipline, the recognition of the need to enhance the discipline, and the desire for life-long learning; and
c) Equip students with a general knowledge of technical and non-technical disciplines so that they are prepared for further study in other fields including professional and graduate education.

Program Educational Objectives (PEOs)

PEOs are broad based statements that describe the objectives of the B.Sc. in EEE program of GUB. It is expected that the graduates of this program will;

1. Be able to develop themselves as leading engineering professionals in the state of art technology and research.

2. Contribute to the society through the use of electrical and electronic engineering principles, practices and tools in an ethical and responsible manner and

3. Continue to learning process and be capable to address evolving challenges in field of electrical and electronic engineering.

Competency Profile of EEE Graduates

General Competencies

The target competencies for the electrical and Electronic Engineering (EEE) program are divided into two groups-general and Academic competencies.

- Ethical
- Socially responsive citizen and leader
- Analytical skills and creative knowledge
- Excellence in Communication
- Assertive and self-confidence
- Entrepreneurial
- Demonstrative
- Motivated
- Conceptual and diagnostic
- Strategic thinker and decision makers

Technical/Academic Competencies

The technical areas require students to gain advanced knowledge, skills and experience in the following areas

- Problem solving skills
- Creativity
- Learning and Adaptation
- Software and Hardware Skills
- System Administration Skills
- Update of knowledge

Types of Courses

Three types of courses are included in the undergraduate curricula. These are core course, pre-requisite course and optional course.

Core Course: A number of courses are identified as core courses, which form the nucleus of the bachelor's degree program in Computer Science and Engineering. A student has to complete the all core courses.

Prerequisite Course: Some of the core courses are identified as prerequisite courses for other courses. A prerequisite course is the one that is required to be completed before taking some other course(s).

Optional Course: Apart from the core courses, the students can choose from a set of optional courses following their area of interests.

Course Category

The letter prefix in any course number indicates the discipline/subject offering the course. Letter symbol for course categories are:

EAP - English for Academic Purpose
EEE – Electrical and Electronic Engineering
CSE – Computer Science and Engineering
ME – Mechanical Engineering
HUM – Humanities
MATH – Mathematics
PHY – Physics
CHEM – Chemistry
PSD – Professional Life Skill Development

Student Advising

One faculty is usually appointed as "Student Adviser" for a group of students by the departmental academic committee. The adviser

advises each student about the courses to be taken in each term. However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student. Based on the academic performance of the previous terms(s), the adviser decides the number and nature of courses the student can register. The adviser may suggest the student to drop/add one or more courses based on previous academic performance.

Registration Procedure

Before the commencement of each semester, a student has to complete pre-registration in consultation with and under the guidance of his/her advisor. The date, time and venue of such registration are announced in advance by the office of the registrar. Much counseling and advising are accomplished at this time. It is essential that all the students be present for pre-registration at the specified time. Based on pre-registration, faculty assignment and final registration will be done. The maximum or minimum number of credits that a student can register in a semester is determined by the course registration policy of the university.

Distribution of Marks

Theory Courses

Name of Examination	**Marks**
Class Attendance	5%
Group Assignment/Project	5%
Individual Presentation	5%
Class Test	15%
Mid Term	30%
Final Exam	40%
Total Marks	**100%**

Lab Courses

Name of Examination	Marks
Class Attendance	10%
Lab Report	10%
Continuous Lab Performance	25%
Project Presentation and Viva	25%
Lab Final Exam	30%
Total Marks	**100%**

Grading System

Letter grading will be made to assess students' performance. The grade will be assigned on the overall evaluation of a student's performance on the basis of semester final examination, midterm exam, case studies, tutorial test, term papers, assignment and class attendance in aggregate and whatever is applicable for an individual program. The teachers responsible for the course will determine Grades/GPA. The final result will be prepared by cumulating the grade point average over the courses. The UGC approved uniform grading system is adopted for assigning a letter grade and grade point. This is given in the following table:

Numerical grade	Letter Grade	Grade point
80 % or Above	A+	4.00
75 % to 79%	A	3.75
70% to 74%	A-	3.50
65% to 69%	B+	3.25
60% to 64%	B	3.00
55% to 59%	B-	2.75
50% to 54%	C+	2.50
45% to 49%	C	2.25
40% to 44%	D	2.00
Less than 40%	F	0.00
	I	Incomplete
	W	Withdrawn

1. “F” means failure. Credits for courses with this grade do not apply towards graduation.
2. “I” grade is given to students who have fulfilled the majority of the course requirements but have been unable to complete the rest.
3. “W” means withdrawal. A student may decide to withdraw from a course by the deadline with the consent of the instructor and the Academic Advisor.

Credit-Hour

Three credit hours are assigned to a theory course if there are three hours lecture in a week. A class period for theory courses will have duration of 1 hour and 30 minutes. One credit of laboratory course will have a minimum of 24 hours of actual lab works per semester and each laboratory class will have duration of 3 hours if it is a 1.5 credit laboratory.

Degree Requirement

a) Completion of minimum 144 credit hours in total.
b) Passing of all courses individually and maintaining a minimum CGPA of 2.50.
c) Full-filling the minimum requirements of each category of the EEE course curriculum.
d) If any student fails in any course, he/she will get the opportunity to improve the grade by retaking the same in the subsequent semester.

Summary of Course Structure

The Bachelor of Science in Electrical and Electronic Engineering (B.Sc. in EEE) program consists of the following categories of courses:

Category	No. of Theory Courses	No. of Sessional/ Lab Courses	Total Credit Hours	
Language & General Education	8 (21 Cr)	1(1.5 Cr)	22.5 (15.62%)	
Basic Science & Mathematics	9 (27 Cr)	2 (3 Cr)	30 (20.83%)	
Other Engineering	2 (6 Cr)	1 (1.5 Cr)	7.5 (5.21%)	
Core (EEE)	15 (45 Cr)	10 (15 Cr)	60	**(58.33%)**
Technical Elective	5 (15 Cr)	2 (3 Cr)	18	
Project and Thesis	-	-	6	
Total	**39**	**16**	**144**	
Total 144 Credits				

Course Structure: (Details with Course tittle and Course Code)

Language and General Education

Category	UGC Min. Requirement (considering 144 credits)	Course Code	Course Title	Credit Hrs.
Language and General Education	15% = 21.06 credits	EAP 009 *	English for Academic Purposes	0
		EAP 101	English for Academic Purposes I	3
		EAP 103	English for Academic Purposes II	3
		HUM 211	Functional Bengali Language	2
		HUM 213	Bangladesh Studies: History of Bangladesh	2
		EAP 204	English Lab	1.5
		HUM 201/ HUM 207	Sociology / Engineering Economics	3
		HUM 405	Industrial Management	3
		HUM 401	Financial and Managerial Accounting	3

		HUM 403	Ethics & Environmental Protection	2
Total	**15.625 %**	**≈**	**22.5 credit**	

***** EAP 009 is waived for the eligible students as stated in Ref. No. ***Letter No. GUB/GC /38 / 18 / 071***

Basic Sciences and Mathematics

Topic	**UGC Min. Requirement (considering 144 credits)**	**Course Code**	**Course Title**	**Credit Hrs.**
Basic Sciences and Mathematics	20% =28.8 credits			
Mathematics:		MATH 101	Differential and Integral Calculus	3
		MATH 103	Ordinary and Partial Differential Equations	3
		MATH 205	Linear Algebra and Complex Variable	3
		MATH 207	Co-ordinate Geometry and Vector Analysis	3
		MATH 209	Probability & Statistics	3
		MATH 301	Numerical Methods	3
		Sub Total 18		

Basic Science:	PHY 101	Physics I (Waves and Oscillations, Optics and Thermodynamics)	3
	PHY 103	Physics II (Electricity and Magnetism, Modern Physics and Mechanics)	3
	PHY 104	Physics Lab	1.5
	CHEM 101	Chemistry	3
	CHEM 102	Chemistry Lab	1.5
	Sub Total		**12**
Total	**20.83 % ≈ 30 credit**		

Other Engineering Subjects:

Topic	UGC Min. Requirement	Course Code	Course Title	Credit Hrs.
Other Engineering	5% = 7.35 Credits	CSE 101	Computer Programming	3
		CSE 102	Computer Programming Lab	1.5
		ME 201	Mechanical Engineering Fundamentals	3
Total	**5.20 % ≈ 7.5 credit**			

Program Courses

Topic	UGC Min. Requirement	Course Code	Course Title	Credit Hrs.

Program Courses	50 % = 72 credits			
Core Courses		EEE 101	Electrical Circuits-I	3
		EEE 103	Electrical Circuits-II	3
		EEE 104	Electrical Circuits Lab	1.5
		EEE 201	Electronics-I	3
		EEE 203	Energy Conversion-I	3
		EEE 205	Engineering Electromagnetics	3
		EEE 207	Energy Conversion-II	3
		EEE 208	Energy Conversion Lab	1.5
		EEE 209	Electronics-II	3
		EEE 214	Electronics Lab	1.5
		EEE 301	Continuous Signals and Linear Systems	3
		EEE 303	Digital Electronics	3
		EEE 304	Digital Electronics Lab	1.5
		EEE 305	Power Systems-I	3
		EEE 307	Communication Theory	3
		EEE 308	Communication Theory Lab	1.5
		EEE 309	Solid State Devices	3
		EEE	Digital Signal Processing	3

	335	I	
	EEE 336	Digital Signal Processing I Lab	1.5
	EEE 302	Numerical Analysis Lab	1.5
	EEE 317	Microprocessors and Interfacing	3
	EEE 318	Microprocessors and Interfacing Lab	1.5
	EEE 401	Control Systems	3
	EEE 402	Control Systems Lab	1.5
	EEE 440	Engineering Drawing & Electrical Service Design	1.5
Project /Thesis	EEE 400	Project/Thesis	6
Sub Total 66			
Technical/Electives	EEE 3**	Elective I	3
	EEE 3**	Elective II	3
	EEE 4**	Elective III	3
	EEE 4**	Elective III Lab	1.5
	EEE 4**	Elective I V	3
	EEE 4**	Elective IV Lab	1.5
	EEE 4**	Elective V	3
Total 58.33 % = Credit			**84**
Grand Total = 144 credits			

Elective Courses

Group A (Communication)		
Course Code	**Course Title**	**Credit Hrs.**
EEE 319	Random Signals and Processes	3
EEE 325	Microwave Engineering	3
EEE 326	Microwave Engineering lab	1.5
EEE 407	Optical Fiber Communications	3
EEE 415	Digital Signal Processing II	3
EEE 423	Digital Communication	3
EEE 424	Digital Communication Lab	1.5
EEE 433	Mobile Cellular Communication	3
EEE 441	Telecommunication Engineering	3
EEE 451	Wireless Communication	3

Group B (Electronics)		
Course Code	**Course Title**	**Credit Hrs.**
EEE 321	Analog Integrated Circuits	3
EEE 329	VLSI I	3
EEE 330	VLSI I Lab	1.5
EEE 409	Compound Semiconductor and Hetero Junction Device	3
EEE 417	Semiconductor Processing and Fabrication Technology	3
EEE 425	VLSI II	3
EEE 426	VLSI II Lab	1.5
EEE 435	Optoelectronics	3

EEE 443	Semiconductor Device Theory	3
EEE 453	Nanotechnology and Nano electronics	3
EEE 455	Medical Electronics	3
EEE 463	FPGA Based System Design	3
EEE 465	Mechatronics and Industrial Automation	3
EEE 481	Electrical Properties of Materials	3

Group C (Power)		
Course Code	**Course Title**	**Credit Hrs.**
EEE 323	Power System II	3
EEE 327	Transmission and Distribution of Electrical Power	3
EEE 333	Power Electronics	3
EEE 334	Power Electronics Lab	1.5
EEE 411	Power Plant Engineering	3
EEE 419	Energy Conversion-III	3
EEE 427	Power System Protection	3
EEE 428	Power System Protection Lab	1.5
EEE 429	High Voltage Engineering	3
EEE 430	High Voltage Engineering Lab	1.5
EEE 437	Power system Reliability	3
EEE 445	Power System Operation and Control	3
EEE 457	Renewable Energy	3
EEE 461	E-Waste and Carbon Footprint	3

Group D (Computer)		
Course Code	**Course Title**	**Credit Hrs.**
EEE 331	Microprocessor System Design	3
EEE 332	Microprocessor System Design Lab	1.5
EEE 413	Real Time Computer System	3
EEE 421	Multimedia Communications	3
EEE 431	Computer Networks	3
EEE 432	Computer Networks Lab	1.5
EEE 439	Computer Architecture	3
CSE 415	Cryptography and Network Security	3
CSE 453	Cyber Security	3

Semester wise course distribution:

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Tri-Semester Wise Course Distribution

Level I, Term I (First Year/Level)

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 101	Electrical Circuit I	Nil	3	-
EAP 009*	English for Academic Purposes	Nil	0.0	-
MATH 101	Differential and Integral Calculus	Nil	3	-
PHY 101	Physics I	Nil	3	-
Total	**(4+ 0) Courses**		**9**	**-**

***** EAP 009 is waived for the eligible students as stated in Ref. No. ***Letter No. GUB/GC /38 / 18 / 071.***

Level I, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EAP 101	English for Academic Purposes I	Nil	3	-
PHY 103	Physics II	PHY 101	3	
PHY 104	Physics Lab	PHY 101	-	1.5
EEE 103	Electrical Circuit II	EEE 101	3	-
EEE 104	Electrical Circuit Lab	EEE 101	-	1.5
Total	**(3+ 2) Courses**		**9**	**3**

Level I, Term III

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
MATH 103	Ordinary and Partial Differential Equations	MATH 101	3	-
EAP 103	English for Academic Purposes II	EAP 101	3	-
CHEM 101	Chemistry	Nil	3	-
CHEM 102	Chemistry Lab	Nil		1.5
CSE 101	Computer Programming	Nil	3	-
CSE 102	Computer Programming Lab	Nil	-	1.5
Total	**(4 + 2) Courses**		**12**	**3**

Level II, Term I (Second Year/Level)

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EAP 204	English Lab	Nil	-	1.5
EEE 201	Electronics I	EEE 101	3	-
HUM 201/ HUM 207	Sociology / Engineering Economics	Nil	3	-
MATH 205	Linear Algebra and Complex Variable	MATH 103	3	

MATH 207	Co-ordinate Geometry and Vector Analysis	MATH 103	3	-
Total	**(4+1) Courses**		**12**	**1.5**

Level II, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 203	Energy Conversion I	EEE 101	3	-
EEE 205	Engineering Electromagnetics	MATH 207	3	-
MATH 209	Probability and Statistics	Nil	3	-
ME 201	Mechanical Engineering Fundamentals	Nil	3	-
Total	**(4 + 0) Courses**		**12**	**-**

Level II, Term III

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 207	Energy Conversion II	EEE 203	3	-
EEE 208	Energy Conversion Lab	EEE 203	-	1.5
EEE 209	Electronics II	EEE 201	3	-
EEE 214	Electronics Lab	EEE 201	-	1.5
HUM 211	Functional Bengali Language	Nil	2	-
HUM 213	Bangladesh Studies :History of Bangladesh	Nil	2	
Total	**(4 + 2) Courses**		**10**	**3**

Level III, Term I (Third Year/Level)

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 301	Continuous Signals and Linear Systems	MATH 207	3	-
EEE 305	Power Systems I	EEE 207	3	-

MATH 301	Numerical Methods	Nil	3	-
EEE 302	Numerical Analysis Lab	Nil	-	1.5
EEE 309	Solid State Devices	PHY 103	3	-
Total	**(4 + 1) Courses**		**12**	**1.5**

Level III, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 303	Digital Electronics	EEE 209	3	-
EEE 304	Digital Electronics Lab	EEE 209	-	1.5
EEE 307	Communication Theory	EEE 301	3	-
EEE 308	Communication Theory Lab	EEE 301	-	1.5
EEE 3**	Elective I	Nil	3	-
Total	**(3 + 2) Courses**		**9**	**3**

Level III, Term III

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 335	Digital Signal Processing I	EEE 301	3	-
EEE 336	Digital Signal Processing Lab	EEE 301	-	1.5
EEE 317	Microprocessor and Interfacing	EEE 303	3	-
EEE 318	Microprocessor and Interfacing Lab	EEE 304	-	1.5
EEE 3**	Elective II	Nil	3	-
EEE 3**	Elective II Lab	Nil	-	1.5
Total	**(3 + 3) Courses**		**9**	**4.5**

Level IV, Term I [Fourth Year/Level]

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 401	Control Systems	EEE 301	3	-
EEE 402	Control Systems lab	EEE 301	-	1.5
HUM 405	Industrial Management	Nil	3	-
EEE 4**	Elective III	Nil	3	-
EEE 4**	Elective III Lab	Nil	-	1.5
Total	**(3 + 2) Courses**		**9**	**3**

Level IV, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 400A	Project/Thesis	Nil	3	-
HUM 401	Financial and Managerial Accounting	Nil	3	-
EEE 440	Engineering Drawing and Electrical Service Design	Nil	-	1.5
EEE 4**	Elective IV	Nil	3	-
HUM 403	Ethics & Environmental Protection	Nil	2	-
Total	**(4 + 2) Courses**		**11**	**1.5**

Level IV, Term III

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 400B	Project/Thesis	-	3	-
PSD 400	Professional Life Skills Development	Nil	0	-
EEE 4**	Elective V	Nil	3	-
Total	**(3 + 0) Courses**		**6**	

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Bi - Semester Wise Course Distribution

Level I, Term I (First Year/Level)

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 101	Electrical Circuit I	Nil	3	-
MATH 101	Differential and Integral Calculus	Nil	3	-
PHY 101	Physics I	Nil	3	-
EAP 009*	English for Academic Purposes	Nil	0.0	-
CSE 101	Computer Programming	Nil	3	-
CSE 102	Computer Programming Lab	Nil	-	1.5
CHEM 101	Chemistry	Nil	3	-
CHEM 102	Chemistry Lab	Nil	-	1.5
Total	**(6+ 2) Courses**		**15**	**3**

***** EAP 009 is waived for the eligible students as stated in Ref. No. ***Letter No. GUB/GC /38 / 18 / 071.***

Level I, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 103	Electrical Circuit II	EEE 101	3	-
EEE 104	Electrical Circuit Lab	EEE 101	-	1.5
MATH 103	Ordinary and Partial Differential Equations	MATH 101	3	-
PHY 103	Physics II	PHY 101	3	
PHY 104	Physics Lab	PHY 101	-	1.5
EAP 101	English for Academic Purposes I	Nil	3	-

HUM 201/ HUM 207	Sociology/ Engineering Economics	Nil	3	-
Total	**(5 + 2) Courses**		**15**	**3**

Level II, Term I (Second Year/ Level)

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 201	Electronics I	EEE 101	3	-
EEE 203	Energy Conversion I	EEE 101	3	-
EAP 103	English for Academic Purposes II	EAP 101	3	-
EAP 204	English Lab I	-	-	1.5
MATH 205	Linear Algebra and Complex Variable	MATH 103	3	-
MATH 207	Co-ordinate Geometry and Vector Analysis	MATH 103	3	-
ME 201	Mechanical Engineering Fundamentals	Nil	3	-
Total	**(6 + 1) Courses**		**18**	**1.5**

Level II, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 205	Engineering Electromagnetics	MATH 207	3	-
EEE 207	Energy Conversion II	EEE 203	3	-
EEE 208	Energy Conversion Lab	EEE 203	-	1.5
EEE 209	Electronics II	EEE 201	3	-
EEE 214	Electronics Lab	EEE 201	-	1.5

MATH 209	Probability and Statistics	-	3	-
HUM 211	Functional Bengali Language	Nil	2	-
HUM 213	Bangldesh Studies: History of Bangladesh	Nil	2	
Total	**(6 + 2) Courses**		**16**	**3**

Level III, Term I (Third Year/Level)

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 301	Continuous Signals and Linear Systems	MATH 207	3	-
EEE 303	Digital Electronics	EEE 209	3	-
EEE 304	Digital Electronics Lab	EEE 209	-	1.5
EEE 305	Power Systems I	EEE 207	3	-
EEE 307	Communication Theory	EEE 301	3	-
EEE 308	Communication Theory Lab	EEE 301	-	1.5
EEE 309	Solid State Device	PHY 103	3	-
EEE 3**	Elective I	-	3	-
Total	**(6 + 2) Courses**		**18**	**3.0**

Level III, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
MATH 301	Numerical Methods	Nil	3	-
EEE 335	Digital Signal Processing I	EEE 301	3	-
EEE 336	Digital Signal Processing Lab	EEE 301	-	1.5
EEE 302	Numerical Analysis Lab	Nil	-	1.5
EEE 317	Microprocessor and Interfacing	EEE 303	3	-
EEE 318	Microprocessor and Interfacing Lab	EEE 304	-	1.5

EEE 3**	Elective II	-	3	-
EEE 3**	Elective II Lab	-	-	1.5
Total	**(4 + 6) Courses**		**12**	**6.0**

Level IV, Term I Fourth Year/Level

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 400A	Project/Thesis	Level 4	3	-
HUM 403	Ethics & Environmental Protection	Nil	2	-
EEE 401	Control Systems	EEE 301	3	-
EEE 402	Control Systems lab	EEE 301	-	1.5
EEE 4**	Elective III	-	3	-
EEE 4**	Elective IV	-	3	-
EEE 4**	Elective IV Lab	-	-	1.5
Total	**(5 + 2) Courses**		**14**	**3**

Level IV, Term II

Course Code	Course Name	Pre-Requisite	Credit Hours	
			Theory	Practical
EEE 400B	Project/Thesis	-	3	-
EEE 4**	Elective V	-	3	
HUM 401	Financial and Managerial Accounting	Nil	3	-
EEE 440	Engineering Drawing and Electrical Service Design	Nil	-	1.5
HUM 405	Industrial Management	Nil	3	-
PSD 400	Professional Life Skills Development	Nil	0	-
Total	**(5 + 1) Courses**		**12**	**1.5**

Pre-requisite courses of elective courses will be decided by the department during course offerings of the semester.

Total number of theory courses is 38 with 114 credits.
Total number of laboratory courses is 16 with 24 credits.
Project/Thesis is one with 6 (3+3) credits.

Comparison between UGC guided Syllabus and EEE Syllabus

Category	UGC requirements (minimum)	Proposed Structure for EEE Dept. GUB
Language and General Education	15%	15.625 % (22.5 credits)
Basic Science & Mathematics	20 %	20.83 % (30 credits)
Other Engineering	5 %	5.20 % (7.5 credits)
Program Courses	50 %	58.83 % (84 credits)

Detail Syllabus

Language and General Education Section:

EAP 009 English for Academic Purposes
0 credit, 3 hours/week
Pre-requisite: Nil

Grammar: Tense and its Classification, Modal Verbs, Pronouns and Possessive, Quantifiers, Degree of Comparison, Tag Questions, Error Correction

Reading: Jigsaw Reading, Guessing Meaning from the Context, Skimming, Scanning, Inferring, Matching Title with the Text,

Writing: Pre-Writing, Brainstorming/Mind mapping, Topic Sentence, Arranging Ideas in order of Importance, Writing Short Paragraphs, Writing Accordion Paragraphs

Speaking: Presentation (Group and Individual), Role Play, Describing Place, Person and Objects, Listening and Practicing Audio Track

Listening: Listening to audio tracks, the lecture of the course teacher, and classmate sand answering questions

EAP 101 English for Academic Purposes I
3 credits, 3 hours/week
Pre-requisite: Nil

Grammar: Reported Speech, Conditionals, Prepositions, Relative Clauses, Causatives, Paired Conjunctions, Use of Words for defining Purpose, Reason and Result, Contrast Words

Reading: Vocabulary, focusing the main theme, identifying the title, searching for the information, providing personal opinion on the passage

Writing: Descriptive Writing, Letter to Editor

Speaking: Discussion Question, picture description, Individual and group presentation on Five Canterbury Tales by Geoffrey Chaucer

Listening: Listening to audio tracks, the lecture of the course teacher, and classmate sand answering questions

EAP 103 English for Academic Purposes II
3 credits, 3 hours/week
Pre-requisite: EAP 101

Grammar: Modifier, Parallel structure, Comma Splice, Fragments, Word Choice, and Punctuation Marks

Reading Comprehension: Comprehensive reading, Scanning, Skimming, Inferring, Critical reading, Critical thinking, Guessing contextual meaning.

Writing: Compare and contrast essay, Writing a news article to be published in a daily

Speaking: Role playing in pairs, Describing situations, places or pictures, Individual and group presentation on the book provided by British Council

Listening: Listening to audio tracks, the lecture of the course teacher, and classmate sand answering questions

EAP 204 English Lab
1.5 credits, 3 hours/week
Pre-requisite: Nil

Based on EAP 101 and EAP 103 focusing on practical skills on Reading, Writing, Listening and Speaking.

HUM 201 Sociology
3 credits, 3 hours/week
Pre-requisite: Nil

Introduction: Society, Science and Technology- an overview; Scientific Study of Society; Social Elements, Society, Community, Association and Institution; Mode of Production and Society Industrial Revolution, Development of Capitalism.

Culture and Socialization: Culture; Elements of Culture; Technology and Culture; Cultural Lag; Socialization and Personality; Family; Crime and Deviance; Social Control. Technology, Society and Development; Industrialization and Development; Development and Dependency Theory; Sustainable Development; Development and Foreign Borrowing; Technology Transfer and Globalization, Modernity and Environment; Problem and Prospects.

Pre-industrial, Industrial and Post-industrial Society: Common Features of Industrial Society; Development and Types of Social Inequality in Industrial Society; Poverty, Technology and Society; Social Stratification and Social Mobility; Rural and Urban Life, and their Evaluation.

Population and Society: Society and Population; Fertility. Mortality and Migration; Science, Technology and Human Migration; Theories of Population Growth-Demographic Transition Theory, Malthusian Population Theory; Optimum Population Theory; Population Policy.

HUM 213 Bangladesh studies: History of Independence
2 credits, 2 hours/week
Pre-requisite: Nil

Society and Culture: the Sociological Perspective, Primary concepts, factors of social life, Social structure and process, Social institutions, Culture and civilization, City and Country, Social change, Problems of Society, Social Problems of Bangladesh, Urbanization Process and

its impact on Bangladesh Society. Bangladesh History: introduction, sources of History, History in nation building; ancient Bengal, ancient geography and trade links with other world-Pal and Sen Dynasty; Medieval Bengal, Muslim conquest of Bengal, Socio-economic and cultural changes, unification of Bengal, the development of Bengali language and literature. The Independent Sultanate in Bengal-Bengal under the Mughal, the Nawabi Rule in Bengal (1700-1765). Modern Period: British colonial rule, introduction of Zamindari system and decline of socio-economic condition, resistance movements, English education and its impact, revival of statehood in Bengal, the growth of Indian National Congress, the creation of new province of East Bengal and Assam, Muslim League (1906), Bengal Pact (1923). Autonomous Bengal (1937 -1947): East Pakistan as a province of Pakistan, establishment of Awami League, Language Movement of *1952,* United Front and Fall of Muslim League, the Military Rule of Ayub Khan, Economic disparity between the two regions, Cultural suppression of West Pakistan, 6-point Movement, Mass upsurge in 1969, the Rule of Yahya Khan, Election of 1970, the War of Independence and the Emergence of Bangladesh.

HUM 207 Engineering Economics
3 credits, 3 hours/week
Pre-requisite: Nil

Introduction to economics. Economics and engineering. Different economic systems. Fundamental economic problems. Basic elements of demand, supply and product market. Theory of utility and preferences, consumer's surplus. Theory of production and cost. Theory of the firm and market structure. Optimization.

Introducing macroeconomics. National income accounting, the simple Keynesian analysis of national income, employment and

inflation. Savings, investment and decision making. Fiscal policy and monetary policy- money and interest rate, income and spending.

Economics of development and planning.

HUM 211 Functional Bengali Language
2 credits, 2 hours/week
Pre-requisite: Nil

প্রথম খন্ড- ভাষাঃ বাংলা ধ্বনি/বাগ ধ্বনি(Phone/Speech Sound), বর্ণ (Letter), অক্ষর (Syllable); বাংলা ধ্বনির উচ্চারণ স্থান ও রীতি (Point of Articulation & Manner of Articulation); বাংলা উচ্চারণ- প্রমিত (Standard), আঞ্চলিক (Dialectal), বৈচিত্র্য (Variation); অপিনিহিতি, অভিশ্রুতি, স্বরসঙ্গতি, শ্বাসাঘাত (Stress accent), স্বরভঙ্গি/স্বরতরঙ্গ (Intonation); বাংলা ও ইংরেজির তুলনা; বাংলা লিখন দক্ষতাঃ সাধু/চলিত রীতি, বিরাম চিহ্ন প্রয়োগ; প্রমিত বাংলা বানানের নিয়ম (বাংলা একাডেমী); ব্যবহারিক বাংলাঃ সংক্ষিপ্ত আলোচনা-একুশে ফেব্রুয়ারি, মুক্তিযুদ্ধ, বাংলাভাষা, বিশ্বায়ন, বাংলার উ□সব, ষড়ঋতু, বাংলা নববর্ষ, আধুনিক তথ্য-প্রযুক্তি, বাংলার লোক সংস্কৃতি, মানবতা ও নৈতিকতা।

দ্বিতীয় খন্ড-সাহিত্যিঃ নির্বাচিত কবিতা - আবদুল হাকিম-নূরনামা, মাইকেল মধুসূদন দত্ত-বঙ্গভাষা, লালন সাঁই-খাঁচার ভিতর অচিন পাখি, রবীন্দ্রনাথ ঠাকুর- নির্ঝরের স্বপ্নভঙ্গ, কাজী নজরুল ইসলাম- আজ সৃষ্টি-সুখের উল্লাসে, জীবনানন্দ দাস-রূপসী বাংলা, হাসান হাফিজুর রহমান- অমর একুশে, আলাউদ্দিন আল আজাদ-স্মৃতি সৌধ, শামসুর রাহমান-তোমাকে পাওয়ার জন্য হে স্বাধীনতা,সৈয়দ শামসুল হক-পরিচয় । **নির্বাচিত প্রবন্ধ** - বঙ্কিম চন্দ্র চট্টোপাধ্যায়-বাঙ্গলা ভাষা, রবীন্দ্রনাথ ঠাকুর- সভ্যতার সংকট, হরপ্রসাদ শাস্ত্রী-তুলি, প্রমথ চৌধুরী-যৌবনে দাও রাজটিকা,কাজী নজরুল ইসলাম-বর্তমান বিশ্বসাহিত্য, মুহম্মদ আব্দুল হাই-আমাদের বাংলা উচ্চারন ,কবীর চৌধুরী-আমাদের আত্ম পরিচয় । **ছোটগল্প অন্যান রচনা** - রবীন্দ্রনাথ ঠাকুর- পোস্ট মাস্টার, রোকেয়া সাখাওয়াত হোসেন-অবরোধ বাসিনী, বিভূতিভূষণ বন্দোপাধ্যায়-পুঁইমাচা, সৈয়দ ওয়ালীউল্লাহ-নয়নচারা, জাহানারা ইমাম-একাত্তরের দিনগুলি, হাসান আজিজুল হক-ঘরগেরস্থি, আখতারুজ্জামান ইলিয়াস-অপঘাত । **নির্বাচিত নাটক** - কবর-মুনির চৌধুরী

রেফারেন্স বইঃ বাংলা বানান - আহমদ শরীফ ও অন্যান্য : বাংলা ভাষার প্রয়োগ ও অপপ্রয়োগ (বাংলা একাডেমী); উচ্চারণের নিয়ম - নরেন বিশ্বাস : বাংলা উচ্চারণ অভিধান (বাংলা একাডেমী); বিরামচিহ্ন - সুভাষ ভট্টাচার্য : তিষ্ঠ ক্ষণকাল (আনন্দবাজার পত্রিকা

লমিটিডে, কলকাতা); ব্যাকরণ ও অন্যান্য - গয়িাস শামীম : বাংলা ব্যাকরণ ও রচনাশলৈী (জুপটিার পাবলকিশেন্স, ঢাকা); ধ্বনবিজ্ঞিান - জীনাত ইমতয়িাজ আলী : ধ্বনবিজ্ঞিানরে ভূমকিা (মাওলা ব্রাদার্স, ঢাকা)।

HUM 401 Financial and Managerial Accounting
3 credits, 3 hours/week
Pre-requisite: Nil

Financial Accounting: Objectives and importance of accounting, branches of accounting, accounting as an information system, computerized system and applications in accounting. Recording System: Double entry mechanism, accounts and their classification, accounting equation, accounting cycle journal, ledger, trial balance. Preparation of financial statements considering adjusting and closing entries. Accounting concepts and conventions. Financial statements analysis and interpretation: ration analysis- tests for profitability, liquidity, solvency and overall measure.

Costs and Management Accounting: Cost concept and classification. Segregation and mixed cost. Overhead cost: meaning and classification, allocation of overhead cost, overhead recovery method. Job order costing: preparation of job cost sheet and quotation price. Inventory valuation: absorption costing and variable costing technique. Cost volume profit analysis: meaning, breakeven analysis, contribution margin approach, sensitivity analysis. Short-term investment decisions: Relevant and differential cost analysis; Linear programming. Long-term investment decisions: Capital budgeting, various techniques of evaluation of capital investment, investment appraisal under uncertainty, risk management, capital rationing. Concept of working capital, need for working capital, management of cash, stock debtors.

HUM 403 Ethics and Environmental Protection
2 credits, 2 hours/week
Pre-requisite: Nil

Definition and scopes of Ethics. Different branches of Ethics. Social change and the emergence of new technologies. History and development of Engineering Ethics. Science and Technology-necessity and application. Study of Ethics in Engineering. Applied Ethics in engineering. Human qualities of an engineer. Obligation of an engineer to the clients. Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession. Ethical Expectations: Employers and Employees; inter-professional relationship: Professional Organization- maintaining a commitment of Ethical standards. Desired characteristics of a professional code. Institutionalization of Ethical conduct.

HUM 405 Industrial Management
3 credits, 3 hours/week
Pre-requisite: Nil

Management Functions and Organization: Evolution, management function: organization, theory and structure, span of control, authority delegation, manpower planning. Personal Management: Importance, need hierarchy, motivation, leadership, wage incentives, performance appraisal, participative management.

Operation Management: Production planning and control (PPC) functions, quantitative methods applied in production, quality management, location and layout planning safety and loss management. Cost and Financial Management: Elements of cost products, cost analysis, investment analysis, benefit cost analysis, risk analysis. Management Accounting: Cost planning and control, budget and budgetary control. Marketing Management: Concepts, strategy, sales promotion, patent laws. Technology Management:

Management of innovation and changes, technology life cycle. Case studies.

Basic Science and Mathematics:

MATH 101 Differential and Integral Calculus
3 credits, 3 hours/week
Pre-requisite: Nil

Differential Calculus: Limits, continuity and differentiability. Successive differentiation of various types of functions. Leibnitz's theorem. Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's theorems in finite and infinite forms. Lagrange's form of remainders. Cauchy's form of remainders. Expansion of functions, evaluation of indeterminate forms of L Hospital's rule. Partial differentiation. Euler's theorem. Tangent and normal. Subtangent and subnormal in cartesian and polar co-ordinates. Determination of maximum and minimum values of functions. Curvature. Asymptotes. Curve tracing.

Integral Calculus: Integration by the method of substitution. Standard integrals. Integration by successive reduction. Definite integrals, its properties and use in summing series. Walli's formulae. Improper integrals. Beta function and Gamma function. Area under a plane curve and area of a region enclosed by two curves in cartesian and polar co-ordinates. Volumes and surface areas of solids of revolution.

MATH 103 Ordinary and Partial Differential Equations
3 credits, 3 hours/week
Pre-requisite: MATH 101

Ordinary Differential Equations: Degree and order of ordinary differential equations, formation of differential equations. Solution of first order differential equations by various methods. Solution of general linear equations of second and higher orders with constant

coefficients. Solution of homogeneous linear equations. Solution of differential equations of the higher order when the dependent or independent variables are absent. Solution of differential equation by the method based on the factorization of the operators. Frobenius method.

Partial Differential Equations: Introduction. Linear and non-linear first order equations. Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients. Wave equations. Particular solution with boundary and initial conditions.

MATH 105 Linear Algebra and Complex Variable
3 credits, 3 hours/week
Pre-requisite: MATH 103

Linear Algebra: Definition of matrices. Algebra of matrices. Transpose of a matrix and inverse of matrix. Factorization. Determinants. Quadratic forms. Matrix polynomials. Euclidean n-space. Linear transformations from IRn to IRm. Properties of' linear transformations from IRn to IRm. Introduction to systems of linear equations. Gaussian elimination. Real vector spaces and subspaces. Basis and Dimension. Rank and Nullity. Linear combination. Linear dependency and Independency. Inner product spaces: Gram-Schmidt process and QR-Decomposition. Eigen values and eigen vectors. Diagonalization. Linear transformations: Kernel and Range., Application of linear algebra to electric networks.

Complex Analysis: Complex Variable: Complex number system. General functions of a complex variable. Limits and continuity of a function of a complex variable and related theorems. Complex differentiation and the Cauchy-Riemann equation. Infinite series. Convergence and uniform convergence. Line integral of a complex function, Cauchy integral formula. Liouville's theorem. Taylor's and Laurent's theorem. Singular points. Residue, Cauchy's residue theorem.

Fourier Series: Real and complex form. Finite transform. Fourier Integral. Fourier transforms and their uses in solving boundary value problems.

MATH 207 Co-ordinate Geometry and Vector Analysis
3 credits, 3 hours/week
Pre-requisite: MATH 103

Co-ordinate Geometry: Two dimensional coordinate geometry: Changes of axes: Transformation of co-ordinates, simplification of equation of curves, Conic section (pair of straight line, system of circle, parabola, Ellipse, Hyperbola). Three dimensional coordinate geometry: System of coordinate, distance between two points, section formula, projections, direction cosines, equations of planes and lines.

Vector Analysis: Multiple product of vectors. Linear dependence and independence of vectors. Differentiation and integration of vectors together with elementary applications. line, surface and volume integrals. Gradient of a scalar function, divergence and curl of a vector function. Various formulae. Integral forms of gradient, divergence and curl. Divergence theorem. Stoke's theorem, Green's theorem and Gauss's theorem.

Laplace Transforms: Definition, Theorems and properties of Laplace transformation. Laplace transforms of some elementary functions; Inverse Laplace transforms; Laplace transforms of derivatives. The unit step function; Periodic function; Some special theorems on Laplace transforms; Partial fraction; Solutions of differential equations by Laplace transforms; Evaluation of improper integrals..

MATH 209 Probability and Statistics
3 credits, 3 hours/week
Pre-requisite: Nil

Introduction: Definition of statistics: Population and Sample, Parameter, Variable, constant and Frequency distribution. Graphical

presentation of Frequency distribution. Sets and Probability, Random Variables, Properties Describing Distributions, Discrete Probability Distributions, Normal Distribution, Sampling Theory, Estimation Theory. Elementary probability theory and discontinuous probability distribution, (binomial, Poisson and negative binomial); Characteristics of distributions; Elementary sampling theory; Estimation; Hypothesis testing and regression analysis.

Measures of central tendency: Arithmetic Mean, median, mode, Geometric mean and harmonic mean. Measures of dispersion: Range, Standard deviation, Mean deviation, Quartile deviation and Variance. Moments, skewness and kurtosis, Mathematical expansion.

MATH 301 Numerical Methods
3 credits, 3 hours/week
Pre-requisite: Nil

Introduction: Introduction to numerical methods and errors in numerical techniques; Taylor series. Finite difference calculus: Forward, backward, divided, and central difference and difference of a polynomial. Interpolation: Newton's formula, Lagrange, spline, Chebyshev and inverse. Extrapolation. Nonlinear equations: Iteration, bisection, false position, Newton-Raphson, Secant and Muller's methods. Simultaneous linear algebraic equations: Cramer's rule, inversion of matrices, Gauss elimination, Gauss-Jordan method, factorization and Gauss-Siedel iteration methods. Curve Fitting: Linear and polynomial regression, fitting power, exponential and trigonometric functions. Ordinary differential equations: Initial value problem, Taylor's series method, Picard's method of successive approximation, Euler's method and Runge Kutta method. Boundary value problems. Numerical integration: general quadrature formula, trapezoidal rule and Simpson's rule. Numerical differentiation.

PHY 101 Physics I (Waves and Oscillations, Optics and Thermal Physics)
3 credits, 3 hours/week
Pre-requisite: Nil

Waves and oscillations: Differential equation of simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, spring mass system, torsional pendulum; two body oscillation, reduced mass, damped oscillation, forced oscillation, resonance, progressive wave, power and intensity of wave, stationary wave, group and phase velocities.

Optics: Defects of images: spherical aberration, astigmatism, coma, distortion, curvature, chromatic aberration. Theories of light; Interference of light: Young's double slit experiment, displacement of fringes and its uses, Fresnel bi-prism, interference in thin films, Newton's rings, interferometers; Diffraction: Diffraction by single slit, diffraction from a circular aperture, resolving power of optical instruments, diffraction at double slit and N-slits, diffraction grating; polarization: Production and analysis of polarized light, Brewster's law, Malus law, polarization by double refraction, Nicol prism, optical activity, Polarimeters.

Thermal Physics: Heat and work: the first law of thermodynamics and its applications; Kinetic Theory of gases: Kinetic interpretation of temperature, specific heats of ideal gases, equipartition of energy, mean free path, Maxwell's distribution of molecular speeds, reversible and irreversible processes, Carnot's cycle, second law thermodynamics, Carnot's theorem, entropy, Thermodynamic functions, Maxwell relations, Clausius and Clapeyron equation.

PHY 103 Physics II (Electricity and Magnetism, Modern Physics and Mechanics)
3 credits, 3 hours/week
Pre-requisite: PHY 101

Electricity and Magnetism: Electric charge and Coulomb's law, Electric field, concept of electric flux and the Gauss's law- some applications of Gauss's law, Gauss's law in vector form, Electric potential, relation between electric field and electric potential, capacitance and dielectrics, gradient, Laplace's and Poisson's equations, Current, Current density, resistivity, the magnetic field, Ampere's law, Biot-Savart law and their applications, Laws of electromagnetic induction- Maxwell's equation.

Modern Physics: Galilean relativity and Einstein's special theory of relativity; Lorentz transformation equations, Length contraction, Time dilation and mass-energy relation, photoelectric effect, Compton effect; De Broglie matter waves and its success in explaining Bohr's theory, Pauli's exclusion principle, Constituent of atomic nucleus, Nuclear binding energy, different types of radioactivity, radioactive decay law; Nuclear reactions, nuclear fission, nuclear fusion, atomic power plant.

Mechanics: Linear momentum of a particle, linear momentum of a system of particles, conservation of linear momentum, some applications of the momentum principle; Angular momentum of a particle, angular momentum of a system of particles, Kepler's law of planetary motion, the law of universal Gravitation, the motion of planets and satellites, introductory quantum mechanics; Wave function; Uncertainty principle, postulates, Schrodinger time independent equation, expectation value, Probability, Particle in a zero potential, calculation of energy.

PHY 104 Physics Lab
1.5 credits, 3 hours/week
Pre-requisite: PHY 101

Laboratory experiments based on PHY 101 and PHY 103.

CHEM 101 Chemistry
3 credits, 3 hours/week
Pre-requisite: Nil

Atomic Structure, quantum numbers, electronic configuration, periodic table. Properties and uses of noble gases. Different types of chemical bonds and their properties. Molecular structures of compounds. Selective organic reactions.

Different types of solutions and their compositions. Phase rule, phase diagram of mono component system. Properties of dilute solutions. Thermo chemistry, chemical kinetics, chemical equilibrium. Ionization of water and pH concept. Electrical properties of solution.

CHEM 102 Chemistry Lab
1.5 credits, 3 hours/week
Pre-requisite: Nil

Volumetric analysis: acid-base titration, oxidation-reduction titrations, determination of Fe, Cu and Ca volumetrically.

Other Engineering Subjects:

CSE 101 Computer Programming
3 credits, 3 hours/week
Pre-requisite: Nil

Introduction to digital computers. Programming languages, algorithms and flow charts. Structured Programming using C:

Variables and constants, operators, expressions, control statements, functions, arrays, pointers, structure unions, user defined data types, input-output and files. Object-oriented Programming using C++: introduction, classes and objects; polymorphism; function and operator overloading; inheritance.

CSE 102 Computer Programming Sessional
1.5 credits, 3 hours/week
Pre-requisite: Nil

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in CSE 101. In the second part, students will learn program design.

ME 201 Mechanical Engineering Fundamentals
3 credits, 3 hours/week
Pre-requisite: Nil

Introduction to sources of energy: Steam generating units with accessories and mountings; steam turbines. Introduction to internal combustion engines and their cycles, gas turbines. Refrigeration and air conditioning: applications; refrigerants, different refrigeration methods. Fluid machinery: impulse and reaction turbines; centrifugal pumps, fans, blowers and compressors. Basics of conduction and convection: critical thickness of insulation.

EEE 101 Electrical Circuits I
3 credits, 3 hours/week
Pre-requisite: Nil

Circuit variables and elements: Voltage, current, power, energy, independent and dependent sources, resistance. Basic laws: Ohm's law, Kirchhoff's current and voltage laws. Simple resistive circuits:

Series and parallel circuits, voltage and current division, wye-delta transformation. Techniques of circuit analysis: Nodal and mesh analysis including super node and super mesh. Network theorems: Source transformation, Thevenin's, Norton's and superposition theorems with applications in circuits having independent and dependent sources, maximum power transfer condition and reciprocity theorem.

Energy storage elements: Inductors and capacitors, series parallel combination of inductors and capacitors. Transient responses of RL, RC circuits and R-L-C circuits: Natural and step responses. Magnetic quantities and variables: Flux, permeability and reluctance, magnetic field strength, magnetic potential, flux density, magnetization curve. Laws in magnetic circuits: Ohm's law and Ampere's circuital law. Magnetic circuits: series, parallel and series-parallel circuits.

EEE 103 Electrical Circuits II
3 credits, 3 hours/week
Pre-requisite: EEE 101

Sinusoidal functions: Instantaneous current, voltage, power, effective current and voltage, average power, phasors and complex quantities, impedance, real and reactive power, power factor.

Analysis of single phase AC circuits: Series and parallel RL, RC and RLC circuits, nodal and mesh analysis, application of network theorems in AC circuits, circuits with non-sinusoidal excitations, transients in AC circuits, passive filters.

Resonance in AC circuits: Series and parallel resonance and Q factor.

Magnetically coupled circuits. Analysis of three phase circuits: Three phase supply, balanced and unbalanced circuits, and power calculation.

EEE 104 Electrical Circuits Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 101

In this course students will perform practical experiments to verify the theories and concepts learned in EEE 101 and EEE 103.

EEE 201 Electronics I
3 credits, 3 hours/week
Pre-requisite: EEE 101

P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, photodiodes and LED, contact potential, current-voltage characteristics of a diode, simplified DC and AC diode models, dynamic resistance and capacitance.

Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a Zener diode, Zener shunt regulator, clamping and clipping circuits.

Bipolar Junction Transistor (BJT) as a circuit element: current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. Single stage mid-band frequency BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): structure and physical operation of FET, JFET and enhancement MOSFET, threshold voltage, Body effect, current-voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.

EEE 203 Energy Conversion I
3 credits, 3 hours/week
Pre-requisite: EEE 101

Transformer: construction, transformation ratio; actual transformer: equivalent circuit, regulation and efficiency, transformer phasor diagram, short circuit and open circuit tests. Polarity of transformer windings, vector group, parallel operation of transformers, harmonics in excitation current, transformer inrush current, three phase transformers, harmonics suppression of three phase transformer, Auto- transformer and instrument transformer.

Three phase induction motor: Rotating magnetic field, equivalent circuit, vector diagram, torque-speed characteristics, construction, types of induction motors, squirrel cage and wound rotor, slips and its effect on frequency and voltage, effect of changing rotor resistance and reactance on torque-speed curves, synchronous speed, motor torque and developed rotor power, no-load test, blocked rotor test, starting and braking and speed control, losses, efficiency and power factor.

Single phase induction motor: Theory of operation, double-field revolving theory, quadrature field theory, equivalent circuit and starting, Torque-speed characteristics and performance calculation.

EEE 205 Engineering Electromagnetics
3 credits, 3 hours/week
Pre-requisite: MATH 207

Static electric field: Postulates of electrostatics, Coulomb's law for discrete and continuously distributed charges, Gauss's law and its application, electric potential due to charge distribution, conductors and dielectrics in static electric field, flux density, boundary conditions; capacitance- electrostatic energy and forces, energy in

terms of field equations, capacitance calculation of different geometries; boundary value problems, Poisson's and Laplace's equations in different co-ordinate systems. Steady electric current: Ohm's law, continuity equation, Joule's law, resistance calculation. Static Magnetic field: Postulates of magnetostatics, Biot-Savart's law, Ampere's law and applications, vector magnetic potential, magnetic dipole, magnetization, magnetic field intensity and relative permeability, boundary conditions for magnetic field, magnetic energy, magnetic forces, torque and inductance of different geometries. Time varying fields and Maxwell's equations: Faraday's law of electromagnetic induction, Maxwell's equations: differential and integral forms, boundary conditions, potential functions; time harmonic fields and Poynting theorem. Plane electromagnetic wave: plane wave in loss less media, Doppler Effect, transverse electromagnetic wave, polarization of plane wave; plane wave in lossy media: low-loss dielectrics, good conductors; group velocity, instantaneous and average power densities, normal and oblique incidence of plane waves at plane boundaries for different polarization.

EEE 207 Energy Conversion II
3 credits, 3 hours/week
Pre-requisite: EEE 203

Synchronous Generator: Construction, excitation systems with brushes and brushless excitation system, equivalent circuit, armature winding connections and harmonic cancellation in distributed short pitched winding, equivalent circuit, vector diagrams at different loads, factors affecting voltage regulation, synchronous impedance test, phasor diagram, salient pole generator, generator equations, equation of developed power and torque of synchronous machine, synchronous impedance method of predicting voltage regulation and its limitations. Parallel operation: Necessary conditions,

synchronizing, circulating current and vector diagram, load distribution of alternators in parallel, droop setting, frequency control, voltage control and house diagram. Introduction to DC generator.

Synchronous motor: Operation, effect of loading under different excitation condition, effect of changing excitation, V-curves and starting, synchronous capacitor and power factor correction.

DC motor: Torque, counter EMF, speed, armature reaction and its effect on motor performance, torque-speed characteristics, starting and speed regulation.

Introduction to wind turbine generations, construction and basic characteristics of solar cells.

EEE 208 Energy Conversion Lab
1.5 credits, 3 hours/week
Pre-requisite: EEE 203

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 203 and EEE 207. In the second part, students will design simple systems using the principles learned in EEE 203 and EEE 207.

EEE 209 Electronics II
3 credits, 3 hours/week
Pre-requisite: EEE 201

Operational amplifiers (Op-Amp): Properties of ideal Op-Amps, non-inverting and inverting amplifiers, inverting integrators, differentiator, weighted summer and other applications of Op-Amp circuits, Low pass, high, band-pass and band-stop active filters,

effects of finite open loop gain and bandwidth on circuit performance, logic signal operation of Op-Amp, DC imperfections.

Frequency response of amplifiers: Poles, zeros and Bode plots, amplifier transfer function, techniques of determining 3 dB frequencies of amplifier circuits, frequency response of single-stage and cascade amplifiers, frequency response of differential amplifiers. General purpose Op-Amp: DC analysis, small-signal analysis of different stages, gain and frequency response of 741 Op-Amp.

Negative feedback: properties, basic topologies, feedback amplifiers with different topologies, stability, frequency compensation. Active filters: Different types of filters and specifications, transfer functions, realization of first and second order low, high and band pass filters using Op-Amps. Signal generators: Basic principle of sinusoidal oscillation, Op-Amp RC oscillators, LC and crystal oscillators.

Power Amplifiers: Basic principle, power transistors, Classification of output stages, class A, B and AB complementary output stages.

EEE 214 Electronics Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 201

In this course students will perform experiments to verify practically the theories and concepts learned in EEE 201 and EEE 209.

EEE 301 Continuous Signals and Linear Systems
3 credits, 3 hours/week
Pre-requisite: MATH 207

Classification of signals and systems: signals and their classification, basic operation on signals, elementary signals, representation of signals using impulse function; classification of systems. Properties

of Linear Time Invariant (LTI) systems: Linearity, causality, time invariance, memory, stability, invertibility.

Time domain analysis of LTI systems: Differential equations, system representation, order of the system, solution techniques, zero state and zero input response, system properties; impulse response- convolution integral, determination of system properties; state variable- basic concept, state equation and time domain solution.

Frequency domain analysis of LTI systems: Fourier series- properties, harmonic representation, system response, frequency response of LTI systems; Fourier transformation- properties, system transfer function, system response and distortion-less systems. Applications of time and frequency domain analyses: solution of analog electrical and mechanical systems, amplitude modulation and demodulation, time-division and frequency-division multiplexing. Laplace transformation: properties, inverse transform, solution of system equations, system transfer function, system stability and frequency response and application.

EEE 303 Digital Electronics
3 credits, 3 hours/week
Pre-requisite: EEE 201

Introduction to number systems and codes. Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic design, minimization of combinational logic. Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits. Modular combinational circuit design: pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design.

Programmable logic devices: logic arrays, field programmable logic arrays and programmable read only memory, RAM, CPLD, FPGA, data converters and digital logic family. Sequential circuits: different types of latches, flip-flops and their design using ASM approach, timing analysis and power optimization of sequential circuits. Modular sequential logic circuit design: shift registers, counters and their applications.

EEE 304 Digital Electronics Lab
1.5 credits, 3 hours/week
Pre-requisite: EEE 201

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 303. In the second part, students will design simple systems using the principles learned in EEE 303.

EEE 305 Power Systems I
3 credits, 3 hours/week
Pre-requisite: EEE 207

Network representation: Single line and reactance diagram of power system and per unit system. Line representation: equivalent circuit of short, medium and long lines, reactive compensation of lines, introduction to DC transmission

Load flow: Gauss- Siedel and Newton Raphson Methods, Load flow through ETAP software

Fault analysis: Short circuit current and reactance of a synchronous machine. Symmetrical fault calculation methods: symmetrical components, sequence networks and unsymmetrical fault calculation.

Power flow control: Tap changing transformer, phase shifting, booster and regulating transformer and shunt capacitor.

Protection: Introduction to relays, differential protection and distance protection, introduction to circuit breakers, typical layout of a substation.

Power plants: types, general layout of a thermal power plant and major components of gas turbine, steam turbine and combined cycle power plants.

EEE 307 Communication Theory
3 credits, 3 hours/week
Pre-requisite: EEE 301

Overview of communication systems: Basic principles, fundamental elements, system limitations, message source, bandwidth requirements, transmission media types, bandwidth and transmission capacity. Noise: Source, characteristics of various types of noise and signal to noise ratio. Information theory: Measure of information, source encoding, error free communication over a noisy channel, channel capacity of a continuous system and channel capacity of a discrete memory less system. Communication systems: Analog and digital. Continuous wave modulation: Transmission types: base-band transmission, carrier transmission; amplitude modulation: introduction, double side band, single side band, vestigial side band, quadrature; spectral analysis of each type, envelope and synchronous detection; angle modulation, instantaneous frequency, frequency modulation (FM) and phase modulation (PM), spectral analysis, demodulation of FM and PM. Pulse modulation: Sampling- sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling; pulse amplitude modulation- principle, bandwidth requirements; pulse code modulation (PCM)- quantization principle, quantization noise, non-uniform quantization, signal to quantization error ratio, differential PCM, demodulation of PCM; delta

modulation (DM): principle, adaptive DM; line coding: formats and bandwidths. Digital modulation: Amplitude-shift keying- principle, ON-OFF keying, bandwidth requirements, detection, noise performance; phase-shift keying (PSK): principle, bandwidth requirements, detection, differential PSK, quadrature PSK, noise performance; frequency-shift keying (FSK): principle, continuous and discontinuous phase FSK, minimum-shift keying, bandwidth requirements, detection of FSK. Multiplexing: Time-division multiplexing (TDM): principle, receiver synchronization, frame synchronization, TDM of multiple bit rate systems; frequency-division multiplexing (FDM): principle, de-multiplexing; wavelength-division multiplexing, multiple-access network: time-division multiple-access (TDMA), frequency-division multiple access (FDMA); code-division multiple-access (CDMA): spread spectrum multiplexing, coding techniques and constraints of CDMA. Communication system design: design parameters, channel selection criteria and performance simulation.

EEE 308 Communication Theory Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 301

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 307. In the second part, students will design simple systems using the principles learned in EEE 307.

EEE 309 Solid State Devices
3 credits, 3 hours/week
Pre-requisite: PHY 103

Semiconductors in equilibrium: Energy bands, intrinsic and extrinsic semiconductors, Fermi levels, electron and hole concentrations, temperature dependence of carrier concentrations and invariance of Fermi level. Carrier transport processes and excess carriers: Drift and diffusion, generation and recombination of excess carriers, built-in-field, Einstein relations, continuity and diffusion equations for holes and electrons and quasi-Fermi level. PN junction: Basic structure, equilibrium conditions, contact potential, equilibrium Fermi level, space charge, non-equilibrium condition, forward and reverse bias, carrier injection, minority and majority carrier currents, transient and AC conditions, time variation of stored charge, reverse recovery transient and capacitance.

Bipolar Junction Transistor: Basic principle of pnp and npn transistors, emitter efficiency, base transport factor and current gain, diffusion equation in the base, terminal currents, coupled-diode model and charge control analysis, Ebers-Moll equations and circuit synthesis.

Metal-semiconductor junction: Energy band diagram of metal semiconductor junctions, rectifying and ohmic contacts. MOS structure: MOS capacitor, energy band diagrams and flat band voltage, threshold voltage and control of threshold voltage, static C-V characteristics, qualitative theory of MOSFET operation, body effect and current-voltage relationship of a MOSFET. Junction Field-Effect-Transistor: Introduction, qualitative theory of operation, pinch-off voltage and current-voltage relationship.

EEE 317 Microprocessor and Interfacing

3 credits, 3 hours/week

Pre-requisite: EEE 303

Basic components of a computer system. Simple-As-Possible (SAP) computer: SAP-1, selected concepts from SAP-2 and SAP-3 (jump, call, return, stack, push and pop), Evolution of microprocessors.

Introduction to Intel 8086 microprocessor: features, architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Minimum mode operation of 8086 microprocessor: system timing diagrams of read and write cycles, memory banks, design of decoders for RAM, ROM and PORT.

Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard and display interface. Introduction to micro-controllers.

EEE 318 Microprocessor and Interfacing Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 304

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 317. In the second part, students will design simple systems using the principles learned in EEE 317.

EEE 440 Engineering Drawing & Electrical Service Design
1.5 credits, 3 hours/week
Pre-requisite: EEE Nil

Familiarization with CAD tools for building services design. Introduction to building regulations, codes and standards: BNBC, NFPA etc. Terminology and definitions: fuses, circuit breakers, distribution boxes, cables, bus-bars and conduits. Familiarization with symbols and legends used for electrical services design. Classification of wiring. Design for illumination and lighting: lux, lumen, choice of luminaries for various applications- domestic

building, office building and industry. Wattage rating of common electrical equipment.

Designing electrical distribution system for low and high rise domestic, office and academic buildings, for multipurpose buildings. Size selection of conductors and breakers, bus-bar trunking (BBT) system for various applications. Single line diagram (SLD) of a typical 1 kV/0.415kV, 500kVA sub- station and a 200kVA pole-mounted transformer.

Earthing requirements, various earthing methods. Earthing and lightning protection system design.

Familiarization with indoor and underground telephone and fiber optic cables, UTP and CAT5/6 data cables. Design of routing layout and installation of intercom, PABX, telephone, public address (PA) systems, cable TV distribution, LAN and wireless data systems for building. Safety regulations, design of security systems including CCTV, burglar alarm.

Concept of fire prevention and its importance. Fire detection (smoke, heat etc.) and alarm system (with voice evacuation), fire-fighting system (sparkler system, hose).

Installation of air-conditioning, heating, lifts and elevators.

EEE 401 Control Systems
3 credits, 3 hours/week
Pre-requisite: EEE 301

Introduction to control systems. Linear system models: transfer function, block diagram and signal flow graph (SFG). State variables: SFG to state variables, transfer function to state variable and state variable to transfer function. Feedback control system: Closed loop systems, parameter sensitivity, transient characteristics of control systems, effect of additional pole and zero on the system response

and system types and steady state error. Routh stability criterion. Design of feedback control system: Controllability and observability, root locus, frequency response and state variable methods. Introduction to PI and PID controller. Analysis of feedback control system: Root locus method and frequency response method.

Digital control systems: introduction, sampled data systems, Closed loop feedback control data system, Performance of a sampled-data (second order system), Closed loop system with digital compensation, Implementation of digital controller, stability analysis in Z-domain. Transient response in z plane, Steady state errors in z plane.

EEE 402 Control Systems Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 301

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 401. In the second part, students will design simple systems using the principles learned in EEE 401.

EEE 302 Numerical Analysis Lab
1.5 credits, 3 hours/week
Pre-requisite: Nil

Laboratory on numerical techniques using computer solution of differentiation and integration problems, transcendental equations, linear and non-linear differential equations and partial differential equations

EEE 335 Digital Signal Processing I
3 credits, 3 hours/week
Pre-requisite: EEE 301

Introduction to digital signal processing (DSP): Discrete-time signals and systems, analog to digital conversion, impulse response, finite impulse response (FIR) and infinite impulse response (IIR) of discrete-time systems, difference equation, convolution, transient and steady state response. Discrete transformations: Discrete Fourier series, discrete-time Fourier series, discrete Fourier transform (DFT) and properties, fast Fourier transform (FFT), inverse fast Fourier transform, z-transformation - properties, transfer function, poles and zeros and inverse z-transform. Correlation: circular convolution, auto-correlation and cross correlation.

Digital Filters: FIR filters- linear phase filters, specifications, design using window, optimal and frequency sampling methods; IIR filters- specifications, design using impulse invariant, bi-linear z-transformation, least-square methods and finite precision effects.

EEE 336 Digital Signal Processing I Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 301

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 405. In the second part, students will design simple systems using the principles learned in EEE 405.

EEE 400 Project/Thesis
3 credits, 6 hours/week for Level 4, Term II
3 credits, 6 hours/week for Level 4, Term III

Study and/or implementation of practical and/or real-life problems in the fields of electrical and electronic engineering.

Elective Courses:

Communication (Group – A):

EEE 319 Random Signals and Processes

3 credits, 3 hours/week
Pre-requisite: EEE 301

Probability and random variables, Distribution and density functions and conditional probability, Expectation: moments and characteristic functions, Transformation of a random variable, Vector random variables, Joint distribution and density, Independence, Sums of random variables. Random Processes, Correlation functions, Process measurements, Gaussian and Poisson random processes, Noise models. Stationarity and Ergodicity, Spectral Estimation, Correlation and power spectrum, Cross spectral densities. Response of linear systems to random inputs. Introduction to discrete time processes, Mean-square error estimation, Detection and linear filtering.

EEE 325 Microwave Engineering

3 credits, 3 hours/week
Pre-requisite: EEE 205

Transmission lines: The Lumped Element Circuit Model for a Transmission Line, Field Analysis of Transmission Lines, Voltage and current in ideal transmission lines, reflection, transmission, standing wave, impedance transformation, Smith chart, impedance matching and lossy transmission lines. Waveguides: general formulation, modes of propagation and losses in parallel plate, rectangular and circular waveguides. Microstrips: Structures and characteristics. Rectangular resonant cavities: Energy storage, losses and Q. Radiation: Small current element, radiation resistance, radiation pattern and properties, Hertzian and half wave dipoles.

Antennas: Mono pole, horn, rhombic and parabolic reflector, array, and Yagi-Uda antenna.

EEE 326 Microwave Engineering Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 205

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 325. In the second part, students will design simple systems using the principles learned in EEE 325.

EEE 407 Optical Fiber Communication
3 credits, 3 hours/week
Pre-requisite: EEE 307

Introduction to optical fiber communication. Light propagation through optical fiber: Ray optics theory and mode theory. Optical fiber: Types and characteristics, transmission characteristics, fiber joints and fiber couplers.

Light sources: Light emitting diodes and laser diodes. Detectors: PIN photo-detector and avalanche photo-detectors. Receiver analysis: Direct detection and coherent detection, noise and limitations.

Transmission limitations: Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises. Optical amplifier: Laser and fiber amplifiers, applications and limitations.

Multi-channel optical system: Frequency division multiplexing, wavelength division multiplexing and co-channel interference.

EEE 415 Digital Signal Processing II
3 credits, 3 hours/week
Pre-requisite: EEE 335

Spectral estimation: Nonparametric methods discrete random processes, autocorrelation sequence, periodogram; parametric method autoregressive modeling, forward/backward linear prediction, Levinson-Durbin algorithm, minimum variance method and Eigen structure method I and II. Adaptive signal processing: Application, equalization, interference suppression, noise cancellation, FIR filters, minimum mean-square error criterion, least mean-square algorithm and recursive least square algorithm. Multirate DSP: Interpolation and decimation, poly-phase representation and multistage implementation. Perfect reconstruction filter banks: Power symmetric, alias-free multi-channel and tree structured filter banks. Wavelets: Short time Fourier transform, wavelet transform, discrete time orthogonal wavelets and continuous time wavelet basis.

EEE 423 Digital Communication
3 credits, 3 hours/week
Pre-requisite: EEE 307

Introduction: Communication channels, mathematical model and characteristics. Probability and stochastic processes. Source coding: Mathematical models of information, entropy, Huffman code and linear predictive coding. Digital transmission system: Base band digital transmission, inter-symbol interference, bandwidth, power efficiency, modulation and coding trade-off. Receiver for AWGN channels: Correlation demodulator, matched filter demodulator and maximum likelihood receiver. Channel capacity and coding: Channel models and capacities and random selection of codes. Block codes and conventional codes: Linear block codes, convolution codes and coded modulation. Spread spectrum signals and system.

EEE 424 Digital Communication Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 308

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 423. In the second part, students will design simple systems using the principles learned in EEE 423.

EEE 433 Mobile Cellular Communication
3 credits, 3 hours/week
Pre-requisite: EEE 307

Introduction: Concept, evolution and fundamentals. Analog and digital cellular systems. Cellular Radio System: Frequency reuse, co-channel interference, cell splitting and components. Mobile radio propagation: Propagation characteristics, models for radio propagation, antenna at cell site and mobile antenna. Frequency Management and Channel Assignment: Fundamentals, spectrum utilization, fundamentals of channel assignment, fixed channel assignment, non-fixed channel assignment, traffic and channel assignment. Handoffs and Dropped Calls: Reasons and types, forced handoffs, mobile assisted handoffs and dropped call rate. Diversity Techniques: Concept of diversity branch and signal paths, carrier to noise and carrier to interference ratio performance. Digital cellular systems: Global system for mobile, time division multiple access and code division multiple access.

EEE 441 Telecommunication Engineering
3 credits, 3 hours/week
Pre-requisite: EEE 307

Introduction: Principle, evolution, networks, exchange and international regulatory bodies.

Telephone apparatus: Microphone, speakers, ringer, pulse and tone dialing mechanism, side-tone mechanism, local and central batteries and advanced features.

Switching system: Introduction to analog system, digital switching systems & space division switching, blocking probability and multistage switching, time division switching and two dimensional switching.

Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing. Modern telephone services and network: Internet telephony, facsimile, integrated services digital network, asynchronous transfer mode and intelligent networks.

Integrated Services Digital Network (ISDN): N- ISDN and B- ISDN, architecture of ISDN, B-ISDN implementation. Digital subscribers loop (DSL), wireless local loop (WLL), FTTx, SONET/SDH, WDM network, IP telephony and VoIP, ATM network and Next Generation Network (NGN). Introduction to cellular telephony and satellite communication.

EEE 451 Wireless Communication
3 credits, 3 hours/week
Pre-requisite: EEE 307

Introduction: Wireless communication systems, regulatory bodies. Radio wave propagation: Free-space and multi-path propagation, ray tracing models, empirical path loss models, large-scale and small-scale fading, power delay profile, Doppler and delay spread, coherence time and bandwidth. Statistical channel models: Time-varying channel models, narrowband and wideband fading models, baseband equivalent model, discrete-time model, space-time model, auto- and cross-correlation, PSD, envelope and power distributions, scattering function. Channel capacity: Flat-fading channels - CSI, capacity with known/partially known/unknown CSI. Frequency-selective fading channels - time-invariant channels, time-varying channels.

Performance of digital modulations: Error and outage probability, inter-symbol interference, MPSK, MPAM, MQAM, CPFSK. Diversity techniques: Time diversity, repetition coding, beyond repetition coding. Antenna diversity: SC, MRC, EGC, space-time coding. Frequency diversity, fundamentals, single-carrier with ISI equalization, DSSS, OFDM. Space-time communications: Multi-antenna techniques, MIMO channel capacity and diversity gain, STBC, OSTBC, QOSTBC, SM, BLAST, smart antennas, frequency-selective MIMO channels. Broadband communications: DSSS, FHSS, spreading codes, RAKE receivers, MC-CDMA, OFDM, OFDMA, multiuser detection, LTE, WiMAX.

Elective Courses: Group B (Electronics)

EEE 321 Analog Integrated Circuits
3 credits, 3 hours/week
Pre-requisite: EEE 303

Analog IC Design: Bipolar, MOS and BiCMOS IC technology and its impact, eggshell analogy, application areas and the future of analog IC design.

Review of transistors: Large and small signal models, compact models for Bipolar, FET, and BiCMOS. Amplifiers with passive and active loads, cascode stages.

Multiple current sources/sinks using Bipolar and FET technologies. Current mirrors: Basic, cascode and active current mirrors; influence of channel modulation, mismatched transistors and error in aspect ratios. Wilson current mirror.

Constant current or voltage references: Supply voltage and temperature independent biasing, band-gap references; constant-g_m biasing. Widlar band-gap voltage reference.

Differential pairs: Differential vs. single-ended operations of simple amplifiers, differential and common mode voltages, common mode rejection ratio (CMRR), input common mode range (ICMR), transfer characteristics, small signal analysis, and frequency response of differential pairs.

Noise: Introduction to noise, types, representation in circuits, noise in single stage and differential amplifiers and bandwidth. Band-gap references: Supply voltage independent biasing, temperature independent biasing, proportional to absolute temperature current generation and constant trans -conductance biasing. Switch capacitor circuits: Sampling switches, switched capacitor circuits including unity gain buffer, amplifier and integrator. Phase Locked Loop (PLL): Introduction, basic PLL and charge pumped PLL.

EEE 329 VLSI I
3 credits, 3 hours/week
Pre-requisite: EEE 303

IC trends, technology and design approaches. MOS device: structure, operation, threshold voltage and characteristics.

Ratioed circuits: NMOS inverter with resistive and transistor load, Pseudo NMOS inverter. Ratioless circuits: CMOS inverters: operation, transfer characteristics, design for equal rise and fall time, propagation delay, rise time, fall time and power consumption estimation. NMOS pass transistor and CMOS pass gate circuits. Buffer chain design to drive large capacitive load.

Integrated circuit fabrication technology: photolithography, CMOS process flow, design rules. Estimation of resistance and capacitance from layout. Layout matching. Stick diagram and area estimation from stick diagram. Reliability issues: Latch-up, electromigration.

Basic logic gates in CMOS. Synthesis of arbitrary combinational logic in CMOS, pseudo-NMOS, dynamic CMOS, clocked CMOS and CMOS domino logic. Structured design: Parity generator, bus arbitration logic, multiplexers based design, programmable logic array (PLA) design. Clocked sequential circuit design: two phase clocking, dynamic shift register. CMOS latches and flip flops.

Subsystem design: 4-bit arithmetic processor: bus architectures, shifter, design of a general purpose ALU. Memory elements design: System timing consideration, three transistor and one transistor dynamic memory cell. Pseudo-static RAM/register cell. 4 transistor dynamic and 6 transistor static CMOS memory cell. 4x4 bit register array and 16 bit static CMOS memory array.

Finite State Machine design: Design of Moore Type and Mealy type FSM using Verilog. Testing VLSI circuits.

EEE 330 VLSI I Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 304

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 329. In the second part, students will design simple systems using the principles learned in EEE 329.

EEE 409 Compound Semiconductor and Hetero-Junction Devices
3 credits, 3 hours/week
Pre-requisite: EEE 309

Compound semiconductor: Zinc-blende crystal structures, growth techniques, alloys, band gap, density of carriers in intrinsic and doped compound semiconductors. Hetero-Junctions: Band alignment, band offset, Anderson's rule, single and double sided hetero-junctions,

quantum wells and quantization effects, lattice mismatch and strain and common hetero-structure material systems. Hetero-Junction diode: Band bending, carrier transport and I-V characteristics. Hetero-junction field effect transistor: Structure and principle, band structure, carrier transport and I-V characteristics. Hetero-structure bipolar transistor (HBT): Structure and operating principle, quasi-static analysis, extended Gummel-Poon model, Ebers-Moll model, secondary effects and band diagram of a graded alloy base HBT.

EEE 417 Semiconductor Processing and Fabrication Technology
3 credits, 3 hours/week
Pre-requisite: EEE 309

Substrate materials: Crystal growth and wafer preparation, epitaxial growth technique, molecular beam epitaxy, chemical vapor phase epitaxy and chemical vapor deposition (CVD). Doping techniques: Diffusion and ion implantation. Growth and deposition of dielectric layers: Thermal oxidation, CVD, plasma CVD, sputtering and silicon-nitride growth. Etching: Wet chemical etching, silicon and GaAs etching, anisotropic etching, selective etching, dry physical etching, ion beam etching, sputtering etching and reactive ion etching. Cleaning: Surface cleaning, organic cleaning and RCA cleaning. Lithography: Photo-reactive materials, pattern generation, pattern transfer and metallization. Discrete device fabrication: Diode, transistor, resistor and capacitor. Integrated circuit fabrication: Isolation – P-N junction isolation, mesa isolation and oxide isolation. BJT based microcircuits, p-channel and n-channel MOSFETs, complimentary MOSFETs and silicon on insulator devices. Testing, bonding and packaging.

EEE 425 VLSI II

3 credits, 3 hours/week

Pre-requisite: EEE 329

Scaling of MOS transistor and interconnect: RC delay modeling, repeaters and cascaded drives. Advanced CMOS nanometer process flow and enhancement of CMOS process, Technology related CAD issues and manufacturing issues, design margin and PVT corners.

Circuit characterization: delay estimation and transistor sizing for minimum delay, crosstalk and noise analysis. High speed digital circuit design techniques, circuit families. Architecture for high speed design: Carry select, carry skip, carry look ahead and tree adders. Modified Booth algorithm, Wallace tree multiplication.

Sequential circuit design: sequencing methods, maximum and minimum delay constrains, clock skew. Design of latches and flip-flops, clock generation and synchronization, High-speed clock generation and distribution.

ASIC Cell based design, standard cell place and route design, timing directed placement design, mixed signal design. Interchange formats: LEF, DEF, SDF, DSPF, SPEF, ALF PDEF, CIF and GDS2. Floor planning, power distribution and I/O design.

Algorithm and architecture for digital processors in verilog, system verilog and system-C: building block for signal processors, digital filters and signal processors, pipelined architecture.

Architecture for arithmetic processors: addition, subtraction, multiplication and division. Complete design of a simple RISC processor. Post-synthesis design validation: timing verification, fault simulation and testing, design for test. High speed and low power memory circuit design: advanced topics in DRAM and SRAM.

EEE 426 VLSI II Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 330

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 425. In the second part, students will design simple systems using the principles learned in EEE 425.

EEE 435 Optoelectronics
3 credits, 3 hours/week
Pre-requisite: EEE 209

Optical properties in semiconductor: Direct and indirect band-gap materials, radiative and irradiative recombination, optical absorption, photo-generated excess carriers, minority carrier life time, luminescence and quantum efficiency in radiation. Properties of light: Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation. Light emitting diode (LED): Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers. Stimulated emission and light amplification: Spontaneous and stimulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback and threshold conditions. Semiconductor Lasers: Population inversion in degenerate semiconductors, laser cavity, operating wavelength, threshold current density, power output, hetero-junction lasers, optical and electrical confinement. Introduction to quantum well lasers. Photo-detectors: Photoconductors, junction photo-detectors, PIN detectors, avalanche photodiodes and phototransistors. Solar cells: Solar energy and spectrum, silicon and Schottkey solar cells. Modulation of light: Phase and amplitude modulation, electro-optic effect, acousto-optic effect and magneto-optic devices. Introduction to integrated optics.

EEE 443 Semiconductor Device Theory
3 credits, 3 hours/week
Pre-requisite: EEE 309

Lattice vibration: Simple harmonic model, dispersion relation, acoustic and optical phonons. Band structure: Isotropic and anisotropic crystals, band diagrams and effective masses of different semiconductors and alloys. Scattering theory: Review of classical theory, Fermi-Golden rule, scattering rates of different processes, scattering mechanisms in different semiconductors, mobility. Different carrier transport models: Drift-diffusion theory, ambipolar transport, hydrodynamic model, Boltzman transport equations, quantum mechanical model, simple applications.

EEE 453 Nanotechnology and Nanoelectronics
3 credits, 3 hours/week
Pre-requisite: EEE 209

Nanotechnology: importance, size scales, quantum size effects, revolutionary applications, potentials. Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.

Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapor deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology. Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques. Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids. Importance of nanoelectronics, Moore's law, ITRS roadmap.

Tunneling devices: quantum tunneling, resonant tunneling diodes. Single electron transistor: Coulomb blockade. Quantum confinement:

wires and dots, carbon nanotubes, graphenes. Brief introductions on Molecular electronics and nanobiology.

EEE-455: Medical Electronics

3 credits, 3 hours/week

Pre-requisite: EEE 335

Electro-physiology and bio-potential recording: The origin of Bio-potentials, bio-potential electrodes, biological amplifiers / instrumentation amplifiers, ECG, EEG, EMG, EOG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.

Physiological Transducers: Classification of transducers, performance characteristics of transducers. Pressure transducers, transducers for body temperature measurement, photoelectric transducers, optical fiber sensor, biosensor and smart sensor

Bio-chemical and non-electrical parameter measurement: pH (Acidity), P_{O2} (Partial Pressure of Oxygen), P_{CO2} (Partial Pressure of Carbon Dioxide), colorimeter, Auto analyzer, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters.

Assist devices: Cardiac pacemakers and Defibrillator: Need for cardiac pacemaker, External Pacemaker, Implantable pacemaker, Types of Implantable pacemakers and recent developments. Programmable pacemaker, Rate-responsive pacemakers, pacing system analyzers, Need for Defibrillator, Dc defibrillators, Implantable Defibrillators, Defibrillator analyzers. Blood Flow Meters: Electromagnetic blood flow meters, different types, Ultrasonic blood flow meters, NMR blood flow meters and Laser Doppler blood flow meters. Dialyzer, Heart lung machine, Blood Glucose Monitoring Devices.

Recent trends in medical instrumentation: Thermograph, endoscopy unit, Laser in medicine, cryogenic application, Introduction to telemedicine.

EEE-463: FPGA Based System Design

3 credits, 3 hours/week

Pre-requisite: EEE 303

Introduction to FPGA Based System. Verilog HDL Coding Style: Lexical Conventions, Ports and Modules, Operators, Gate Level Modeling, System Tasks and Compiler Directives, Test Bench, Data Flow Modeling, Behavioral level Modeling, Tasks and Functions.

Verilog Modeling of Combinational and Sequential Circuits: Behavioral, Data Flow and Structural Realization, Adders, Multipliers, Comparators, Flip Flops, Realization of Shift Register, Realization of a Counter, Synchronous and Asynchronous FIFO, Single port and Dual port RAM, Pseudo Random LFSR, Cyclic Redundancy Check.

Synchronous sequential circuit: State diagram-state table, state assignment-choice of flip-flops, Timing diagram, One hot encoding, Mealy and Moore state machines, Design of serial adder using Mealy and Moore state machines, State minimization, Sequence detection, Design of vending machine using One Hot Controller.

FPGA and its Architecture: Types of Programmable Logic Devices: PLA & PAL- FPGA Generic Architecture. ALTERA Cyclone II Architecture, Timing Analysis and Power analysis using Quartus SOPC Builder, NIOS-II Soft-core Processor, System Design Examples using ALTERA FPGAs, Traffic light Controller, Real Time Clock, Interfacing using FPGA: VGA, Keyboard, LCD.

EEE-465: Mechatronics and Industrial Automation
3 credits, 3 hours/week
Pre-requisite: EEE 401

Introduction to Mechatronics. Scope of Mechatronics in manufacturing and products. Fundamentals of numerical control: Advantages, Classification and features. Fundamentals of machining: Design consideration of NC machine tools, Methods of improving machine accuracy and productivity, and Special tool holders

System devices: System drives-hydraulic systems, DC motors, stepper motors, Feedback devices, pulse digitizers, resolvers, Inductosyn, tachometers, counting Devices. Interpolation: linear interpolator-circular interpolators, CNC software interpolator; Flow of data in NC machines.

Programming: Computer aided programming with examples.

Industrial Robotics: Basic concepts, Robotics and automation, Specification of Robots, Resolution, Repeatability and accuracy of manipulator, Classification of Robots, Industrial Application.

EEE 481 Electrical Properties of Materials
3 credits, 3 hours/week
Pre-requisite: PHY 103

Crystal structures: Types of crystals, lattice and basis, Bravais lattice and Miller indices. Classical theory of electrical and thermal conduction: Scattering, mobility and resistivity, temperature dependence of metal resistivity, Mathiessen's rule, Hall Effect and thermal conductivity. **Introduction to quantum mechanics**: Wave nature of electrons, Schrodinger's equation, one-dimensional quantum problems- infinite quantum well, potential step and potential barrier; Heisenbergs's uncertainty principle and quantum box.

Band theory of solids: Band theory from molecular orbital, Bloch theorem, Kronig-Penny model, effective mass, density-of-states. Carrier statistics: Maxwell-Boltzmann and Fermi-Dirac distributions, Fermi energy. Modern theory of metals: Determination of Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat.

Dielectric properties of materials: Dielectric constant, polarization: electronic, ionic and orientational; internal field, Clausius-Mosotti equation, spontaneous polarization, frequency dependence of dielectric constant, dielectric loss and piezoelectricity.

Magnetic properties of materials: Magnetic moment, magnetization and relative permittivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains. Introduction to superconductivity: Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density.

Elective Courses: Group C (Power)

EEE 323 Power System II
3 credits, 3 hours/week
Pre-requisite: EEE 305

Stability: swing equation, power angle equation, equal area criterion, multi-machine system, step by step solution of swing equation. Factors affecting stability. Economic Operation within and among plants, transmission-loss equation, dispatch with losses. Flexible AC transmission system (FACTS): introduction, shunt compensation (SVC, STATCOM), series compensation (SSSC, TCSC, TCSR, TCPST), series-shunt compensation (UPFC). Power quality: voltage sag and swell, surges, harmonics, flicker, grounding problems; IEEE/IEC standards, mitigation techniques.

EEE 327 Transmission and Distribution of Electrical Power
3 credits, 3 hours/week
Pre-requisite: EEE 305

Transmission System: Types of conductors, resistance, definition of inductance, inductance of conductor due to internal flux, flux linkages between two points external to an isolated conductor, inductance of a single phase two wire line, composite conductors, bundled conductors and double circuits, transposition techniques.

Capacitance of transmission lines: Capacitance of a three-phase line with equilateral spacing and unsymmetrical spacing, effect of earth on the capacitance of three-phase transmission lines, bundled conductors, parallel circuit of three-phase lines.

Underground cables: underground cables versus overhead lines conductors, construction, resistance and capacitance of underground cables, insulating materials, electrostatic stress grading, three core cables, dielectric losses and heating, modern developments, oil-filled and gas-filled cables, measurement of capacitance, cable testing.

Insulators for overhead lines: Types of insulators, their constructions and performances, potential distribution, special types of insulators, testing of insulators. Mechanical characteristics of transmission lines: Sag and stress analysis, ice and wind loading. Supports at different elevations, conditions of erection, effect of temperature changes. Transmission lines and cables: overhead and underground. Reactive power compensation: theory, steady-state and dynamic VAR compensation.

Distribution: Distributor calculations, copper efficiencies, radial, ring mains and inter connections, distribution losses and feeder configuration.

Flexible AC transmission system: Basics of series and shunt compensation, introduction, shunt compensation (SVC, STATCOM), series compensation (SSSC, TCSC, TCSR, TCPST), series-shunt compensation (UPFC).

High voltage DC transmission system: Comparison of DC and AC transmission system, HVDC transmission system components, monopolar and bipolar HVDC transmission, power converters: current source and voltage source converters, operation and control of HVDC transmission lines. Introduction to smart grid.

EEE 333 Power Electronics
3 credits, 3 hours/week
Pre-requisite: EEE 209

Power semiconductor switches and triggering devices: BJT, MOSFET, SCR, IGBT, GTO, TRIAC, UJT and DIAC. Rectifiers: Uncontrolled and controlled single phase and three phase. Regulated power supplies: Linear-series and shunt, switching buck, buck boost, boost and Cuk regulators. AC voltage controllers: single and three phase. Choppers. DC motor control. Single phase cyclo-converter. Inverters: Single phase and three phase voltage and current source. AC motor control. Stepper motor control. Resonance inverters. Pulse width modulation control of static converters.

EEE 334 Power Electronics Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 214

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 333. In the second part, students will design simple systems using the principles learned in EEE 333.

EEE 411 Power Plant Engineering

3 credits, 3 hours/week

Pre-requisite: EEE 305

Classification of power plant: Methods of general classification, comparison of costs of different types of thermal power plant, world electricity generation by different fuel types.

Fuel Resources for electricity generation: Fossil fuels; Formation of fossil fuels, Geologic setting of fossil fuels, Formation of coal. Fossil fuel reserves; Coal, proven crude oil anal gas reserve of different countries, reserve to production ratios, consumption to production patterns, major exporting and importing countries.

General Layout of Plants: Non-nuclear thermal; gas turbine, steam turbine, combined cycle; Nuclear, hydro-electric, wind turbine generator.

Power plant fundamentals:

Steam power plant: Parts and components: pressure and temperature at different stages, coal and ash handling arrangement, steam generation, types of steam, economizer, air preheater, deaerator, flue gas stack (chimney) and coal gasification, steam turbine, alternator, feed water, cooling arrangement, control system: conventional system and DCS.

Gas turbine plant: Open cycle and closed cycle, compressor, combustion chamber.

Combined cycle plant: Heat recovery steam generator, single shaft, Dual Shaft.

Nuclear Power Plant:

Nuclear energy: isotope, rays, changing mass to energy, enriched uranium, release of energy by nuclear reaction, initiations of nuclear reactions, chain reaction.

Reactors: General components, fuels, moderator, coolant, shielding. Different types of reactor, Energy harvesting principle, advantages and disadvantages.

Hydro power plant: Hydro potential energy, types of hydroelectric plants, Hydro potential at different places of the world. Major components of hydro plants. Determination of plant capacity at a particular site, environmental impact, advantages and disadvantages.

Site selection: Factors of site selection, land requirement.

EEE 419 Energy Conversion III
3 credits, 3 hours/week
Pre-requisite: EEE 207

Special machines: series universal motor, permanent magnet DC motor, unipolar and bipolar brush less DC motors, stepper motor and control circuits. Reluctance and hysteresis motors with drive circuits, switched reluctance motor, electro static motor, repulsion motor, synchronous and control transformers. Permanent magnet synchronous motors. Acyclic machines: Generators, conduction pump and induction pump. Magneto hydrodynamic generators.

Basic principles of energy conversion: electromagnetic, electrostatic, thermoelectric, electrochemical, and electromechanical. Vector control, linear motors and traction. Photovoltaic systems: stand alone and grid interfaced. Induction generator, AC-DC-AC conversion.

EEE 427 Power System Protection
3 credits, 3 hours/week
Pre-requisite: EEE 305

Introduction: Necessity of power system protection. Instrument transformer: PT, CT, CT error and Burden.

Relay: construction, electromechanical relay, solid state, numerical relay, Relay types and characteristics: over current, directional, impedance, differential and pilot.

Criteria for detecting faults: over current, differential current, difference of phase angles, over and under voltages, power direction, symmetrical components of current and voltages, impedance, frequency and temperature.

Circuit Breaker: types- Air circuit breaker (ACB), Air break CB, Oil CB, Vacuum CB, Air blast CB, SF6 CB, HVDC CB, Miniature circuit breakers and fuses, selection criteria and ratings of circuit breakers. Calculation of breaking capacity of circuit breakers by ETAP software. Introduction to Arc and Arc extinction, Principle of arc extinction, Circuit breaking transients, transient recovery voltage (TRV), resistance switching, first pole to clear factor, double frequency transients. Impacts of natural frequency, power factor on TRV rate of rise of TRV, $RRRV_{max}$.

Basic tripping circuit, Sequence of operation of protecting devices during closing and opening CB, Protective Zones.

Unit protection schemes: Generator, transformer, motor, bus bar, transmission and distribution lines.

EEE 428 Power System Protection Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 208

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 427. In the second part, students will design simple systems using the principles learned in EEE 427.

EEE 429 High Voltage Engineering
3 credits, 3 hours/week
Pre-requisite: EEE 305

High voltage DC: Rectifier circuits, voltage multipliers, Van-de-Graaf and electrostatic generators. High voltage AC: Cascaded transformers and Tesla coils. Impulse voltage: Shapes, mathematical analysis, codes and standards, single and multi-stage impulse generators, tripping and control of impulse generators. Breakdown in gas, liquid and solid dielectric materials. Corona. High voltage measurements and testing. Over-voltage phenomenon and insulation coordination. Lightning and switching surges, basic insulation level, surge diverters and arresters.

EEE 430 High Voltage Engineering Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 208

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 429. In the second part, students will design simple systems using the principles learned in EEE 429.

EEE 437 Power System Reliability
3 credits, 3 hours/week
Pre-requisite: EEE 305

Review of probability concepts. Probability distribution: Binomial, Poisson, and Normal. Reliability concepts: Failure rate, outage, mean time to failure, series and parallel systems and redundancy. Markov process. Probabilistic generation and load models. Reliability indices: Loss of load probability and loss of energy probability. Frequency and duration. Reliability evaluation techniques of single area system.

EEE 445 Power System Operation and Control
3 credits, 3 hours/week
Pre-requisite: EEE 305

Overview: vertically integrated vs. deregulated power system. Real-time operation: SCADA; EMS (energy management system); various data acquisition devices- RTU, IED, PMU, DFDR, WAMPAC (wide area monitoring, protection and control). Application functions: state estimation; short term load forecasting; unit commitment (UC); economic dispatch (ED); optimal power flow (OPF). Frequency control: generation and turbine governors, droop, frequency sensitivity of loads, ACE (area control error), AGC (Automatic Generation Control) and coordination with UC and ED; frequency collapse and emergency load shed.

Power System Security: static and dynamic; security constrained OPF. Electricity market operation: GenCos, ISO, DisCos, bidding, spot market, social welfare, market clearing price (MCP), locational marginal price (LMP), bilateral contacts and forwards market, hedging. Demand side control: DMS (distribution management system), DSM (demand side management) and smart grid concept.

EEE 457 Renewable Energy
3 credits, 3 hours/week
Pre-requisite: EEE 305

Renewable energy sources: Solar, wind, mini-hydro, geothermal, biomass, wave and tides. Solar Photovoltaic: Characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, sun tracking systems, Maximum Power Point Tracking (MPPT): chopper, inverter. Sizing the PV Panel and Battery pack in stand- alone PV applications. Modern solar energy applications (residential, electric vehicle, naval, and space). Solar power plants concentrated to grid. Solar thermal: principles of concentration, solar tower, parabolic

dish, receiver, storage, steam turbine and generator. Wind turbines: Wind turbine types and their comparison, power limitation, Betz's law; Control mechanism: pitch, yaw, speed. Couplings between the turbine and the electric generator, wind turbine generator: DC, synchronous, self-excited induction generator and doubly fed induction generator. Grid interconnection: active power control. Introduction to wave and tidal energy, Biogas and Biogas electricity generation.

Introduction to wind turbine generators construction, basic principle, operation and control and basic characteristics of solar cells.

EEE-461: E-Waste and Carbon Foot Print
3 credits, 3 hours/week
Pre-requisite: Nil

E-waste Extractions and processing of the minerals used in electronic industry, manufacture, finished products, Disposals of reuse and recycling of electronic devices.

Carbon footprint: Carbon footprint of electronics, Effects of recycling on carbon emissions. Greenhouse gas emissions: Sources of emission, emission of CO_2 and Methane (CH_4)

Direct emission: Environmental effect of aviation, measurement of carbon footprint.

Indirect emission: Carbon footprints of product; Food, Textile, Materials, cements. Schemes to reduce carbon emissions: Kyoto protocol, carbon offsetting and certification, carbon footprint reducing technologies.

Elective Courses: Group D (Computer)

EEE 331 Microprocessor System Design

3 credits, 3 hours/week

Pre-requisite: EEE 317

Review of 8086 family of microprocessors. Instructions and data access methods in a 32 bit microprocessor; Representation of operands and operators; Instruction formats; Designing Arithmetic Logic Unit; Processor design: single bus, multi-bus architecture; Control Unit Design: hardwired, micro-programmed and pipe line; VLSI implementation of a microprocessor or part of a microprocessor design.

EEE 332 Microprocessor System Design Laboratory

1.5 credits, 3 hours/week

Pre-requisite: EEE 318

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 331. In the second part, students will design simple systems using the principles learned in EEE 331.

EEE 413 Real Time Computer System

3 credits, 3 hours/week

Pre-requisite: EEE 317

Introduction to real time system; Classification of real time process; Real time scheduling; Real time programming; Implementation; Operating systems; Real time I/O. Real Time design methodologies. Modeling for real time systems. Reliable and Safe design for critical applications.

Review of Microprocessor fundamentals and programmable input/output devices and systems for PC. Application examples: digital controls, robotics, on line systems, communication with real world signals and automatic control using feedback, feed-forward and adaptive control, control algorithm implementation.

EEE 421 Multimedia Communications

3 credits, 3 hours/week

Pre-requisite: EEE 307

Types of media. Multimedia signal characteristic: sampling, digital representation, signal formats. Signal coding and compression: entropy coding, transform coding, vector quantization. Coding standards: H.26x, LPEG, MPEG. Multimedia communication networks: network topologies and layers, LAN, MAN, WAN, PSTN, ISDN, ATM, internetworking devices, the internet and access technologies, enterprise networks, wireless LANs and wireless multimedia. Entertainment networks: cable, satellite and terrestrial TV networks, ADSL and VDSL, high speed modems. Transport protocols: TCP, UDP, IP, Ipv4, Ipv6, FTP, RTP and RTCP, use of MPLS and WDMA. Multimedia synchronization, security, QoS and resource management. Multimedia applications: The www, Internet telephony, teleconferencing, HDTV, email and e-commerce.

EEE 431 Computer Networks

3 credits, 3 hours/week

Pre-requisite: EEE 307

Switching and multiplexing; ISO, TCP-IP and ATM reference models. Different Data Communication Services: Physical Layer-wired and wireless transmission media, Cellular Radio: Communication satellites; Data Link Layer: Elementary protocols, sliding window protocols. Error detection and correction, HDLC, DLL of internet, DLL of ATM; Multiple Access protocols, IEEE.802

Protocols for LANs and MANs, Switches, Hubs and Bridges; High speed LAN; Network layer: Routing, Congestion control, Internetworking, Network layer in internet: IP protocol, IP addresses, ARP; NI in ATM transport layer: transmission control protocol. UDP, ATM adaptation layer; Application layer: Network security; Email, Domain Name System; Simple Network Management Protocol; HTTP and World Wide Web.

EEE 432 Computer Networks Laboratory
1.5 credits, 3 hours/week
Pre-requisite: EEE 308

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 431. In the second part, students will design systems using the principles learned in EEE 431.

EEE 439 Computer Architecture
3 credits, 3 hours/week
Pre-requisite: EEE 317

Instructions and data access methods; Arithmetic Logic Unit (ALU) design: arithmetic and logical operations, floating point operations; Processor design: data paths- single cycle and multi cycle implementations; Control Unit design: hardware and micro-programmed Pipeline- pipelined data path and control, hazards and exceptions. Memory organization: cache, virtual memory; Buses; Multiprocessors, type of multiprocessor performance, single bus multiprocessors, clusters.

CSE 415 Cryptography and Network Security
3 credits, 3 hours/week
Pre-requisite: Nil

Course Brief: Classical Cryptography: Introduction to simple cryptosystems, Cryptanalysis; Shannon's Theory: Perfect secrecy, Entropy, Product cryptosystems; Data Encryption Standard: Description of DES, Differential cryptanalysis; RSA System and Factoring: Public-key cryptography, RSA cryptosystem, Attacks on RSA, Factoring algorithms; Other Public-key cryptosystems: ElGamal cryptosystem and discrete logs, Merkle-Hellman Knapsack System; Signature Schemes: ElGamal signature schemes, Digital signature standard, Fail-stop signatures; Hash Functions: Signatures and Hash functions, Collision-free Hash functions, Birthday attack; Key Distribution and Key Agreement: Key pre-distribution, Kerboros, Diffie-Hellman key exchange; Identification Schemes: Schnorr identification scheme, Okamoto identification schemes; Authentication Codes: Computing deception probabilities, Combinatorial bounds, Entropy bounds; Secret Sharing Schemes: Shamir threshold scheme, Access structure and general secret sharing; Pseudo-random Number Generation: Indistinguishable probability distribution, probabilistic encryption; Zero-knowledge proofs: Interactive proof systems, computational Zero-knowledge proofs.

CSE 453 Cyber Security
3 credits, 3 hours/week
Pre-requisite: Nil

Course Brief: The Security Environment: Threats, vulnerabilities, and consequences, Advanced persistent threats, The state of security today; concepts of information security: security principles, access control mechanisms, authentication schemes; operating system security: classic security models, common vulnerabilities, Linux and Windows security; cyber-attacks: examples, tools, and methodologies, network security: firewall, intrusion detection system; cyber defense techniques; cyber forensics: tools, mechanisms, challenges; cyber-

ethics: cybercrimes, intellectual properties, privacy, etc. The course includes continuous assessment in the form of examinations, projects, and term paper