BE Degree Program in Electrical and Electronics Engineering

1. Context of Curriculum Design

Design of any program in engineering requires statements on what engineering is and who is considered to be a good engineer. While there is no unique definition of what engineering is, the operative definition that captures all aspects of engineering is taken to be

"**Engineering is finding and delivering optimal solutions to real life technical problems, within the given material, technological, economic, social and environmental constraints, through the application of available knowledge from mathematics, science, technology, engineering science and engineering practice."**

Today's engineer has to function in a world characterized by

- Information and communication technologies are completely redefining how work is carried out and business is organized and conducted.
- Large scale demographic changes are taking place in every country with population increases in Asian and African countries and practically zero percent growth in advanced countries.
- Economic scenario changes continuously.
- Hunger, poverty, public health, sustainability, energy, climate change, pollution, water resources and security constitute the great problems that face the humanity.

Engineers are at the centre of all these developments, and also have to grapple with the consequences of all the new technologies and products. Engineering programs are to be designed and conducted to train graduating engineers to work and contribute to the well being of the society, which is the supposed objective of engineering. The desirable traits of a good graduating engineer are decided by the requirements of the profession at the given time. The design of BE program in Electrical and Electronic Engineering is undertaken within the following framework

- India is a signatory to the Washington Accord which ensures global mobility of its graduate engineers. All undergraduate engineering programs are to designed and conducted to meet the Program Outcomes as identified by National Board of Accreditation (NBA).
- An academic year has two semesters. The first semester is normally from August to December (~18 weeks) and the second semester from February to June (~18 weeks).
- All engineering programs follow the credit system. One Lecture hour/week, one tutorial hour/week and two/three hour laboratory/week over a semester is considered to be one credit.
- The number of credits for the program is chosen to ensure good learning by the students.

2. Context of Electrical and Electronic Engineering Program

It is recognized that the Electrical and Electronic Engineering BE program has to be designed in the context defined by

- Access, availability and quality of electrical power supply are the keys to economic progress and quality of life.
- Large and micro grid management is becoming increasingly important

- It is becoming necessary to significantly increase the percentage share of renewable sources of energy
- There is urgent need to reduce power consumption at every level
- Electronics industry is predominantly driven by technology and electronic product life cycles are becoming shorter.
- Cost/performance ratios of electronic products and systems continuously decrease.
- A large percentage of electrical and electronic products are portable and Internet enabled.
- Information, communication and electronics technologies are completely redefining how work is carried out and how business is organized and conducted.
- Large scale demographic changes taking place in every country with population increases in Asian and African countries and practically zero percent growth in advanced countries.
- Continuously changing global economic and political scenarios.
- Changing social and environmental scenarios where hunger, poverty, public health, sustainability, climate change, water resources and security constitute the great problems that face the humanity in general and particularly India at present.
- India is particularly characterized by large religious, linguistic and cultural diversity.

3. Vision and Mission of Electrical and Electronics Engineering Department

Vision of the College

To evolve into an autonomous institute of national standing for imparting quality higher technical education

Mission of the College

- Set up and implement quality assurance processes to ensure an environment that is conducive for our engineering students to graduate as competent, ethical, self-motivated and socially aware individuals.
- Establish close ties with industry to ensure students and faculty get opportunities to address and solve real world engineering problems and to facilitate placement of students.
- Encourage faculty to contribute to Scholarship of Teaching and Learning to ensure continual innovations in all academic and support activities
- Nurture a sound research and development eco system to encourage students and faculty to work on projects using contemporary and emerging technologies, and publish in quality conferences and Journals

Vision of the Department of Electrical and Electronics Engineering

To evolve into a Department of national standing for imparting quality higher education in Electrical and Electronics Engineering

Mission of the Department of Electrical and Electronics Engineering

- Set up and implement quality assurance processes to ensure an environment that is conducive for our electrical and electronic engineering students to graduate as competent, ethical, self-motivated and socially aware individuals.
- Establish close ties with agencies and industries associated with electrical and electronic engineering to ensure students and faculty get opportunities to address and solve real world engineering problems and to facilitate placement of students.

- Encourage faculty to contribute to Scholarship of Teaching and Learning to ensure continual innovations in all academic and support activities
- Nurture a sound research and development eco system to encourage students and faculty to work on projects using contemporary and emerging electrical and electronic technologies, and publish in quality conferences and Journals

4. Program Educational Objectives

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. They must be consistent with the mission of the Institution and Department.

The key aspects of Mission statements include

M1. Competent, ethical, self-motivated and responsible individuals

M2. Solving real world problems

M3. Working closely with agencies and industries associated with electrical and electronic engineering

M4. Research in and development of electrical and electronic products and systems that use emerging and contemporary technologies

M5. Publish in refereed conferences and Journals

M6. Scholarship of teaching and learning

PEOs of the Electrical and Electronics Engineering BE program are

PEO1 Engage in design of systems, tools and applications in the field of electrical and electronics engineering and allied engineering industries

PEO2 Apply the knowledge of electrical and electronics engineering to solve problems of social relevance, and/or pursue higher education and research

PEO3 Work effectively as individuals and as team members in multidisciplinary projects

PEO4 Engage in lifelong learning, career enhancement and adopt to changing professional and societal needs

The relationship of PEOs to the stated Mission of the Electrical and Electronics Engineering Department is presented in the PEO-Mission Matrix

PEO	M1	M2	M3	M4	M5	M6
PEO1		2	2	3		
PEO2	2	3		2	3	1
PEO3	1		3	2	2	
PEO4	3	2				2

1: Slightly 2: Moderately 3: Substantially

5. Program Outcomes and Program Specific Outcomes

The Program Outcomes are the skills and knowledge which the students have at the time of graduation. These Outcomes are generic and are program non-specific. The BE programs are designed to meet the **Program Outcomes** as identified by National Board of Accreditation and Program Specific Outcomes chosen by the Department of Electrical and Electronic Engineering.

Program Outcomes as stated by NBA: Engineering Graduates will be able to

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs) are outcomes specific to the program are selected by the faculty of the Department in consultation with the stakeholders as

PSO1. Specify, architect and analyze power systems that efficiently generate, transmit and distribute electrical power in the context of present ICT.

PSO2. Analyze, specify and design modern electrical drive systems.

PSO3. Specify, design, implement and test analog and embedded signal processing electronic systems using the state of the art components and software tools.

Program Educational Objectives are to be achieved through conducting a program that attains Program Outcomes and Program Specific Outcomes. This relationship is presented through PEO-PO/PSO matrix.

PEO	PO 1	PO 2	PO 3	PO 4	P0 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	P01 2	PSO 1	PSO 2	PS0 3
PEO 1	3	3	3	2	2	1	2	1	1	2	1	2	3	3	3
PEO 2	3	3	3	2	2	1	2	1	1	2	1	2	3	3	3
PEO 3									3	2			1	1	1
PEO 4									2			3	1	1	1

1: Slightly 2: Moderately 3: Substantially

6. Credits of UG Program in Engineering: Knowledge in all areas of Engineering and Science is exponentially growing. There is no way in which it is possible to include in curriculum what is considered to be adequate. The only thing that can be attempted is to facilitate students learn well or learn meaningfully. Learning well is understood as acquiring knowledge and skills at higher cognitive levels, which include Apply, Analyze, Evaluate and Create. Such learning is ensured by making it heavily activity and practice oriented rather than lecture oriented. The credit load of undergraduate programs is taken to be initially as 175 credits.

7. Credit Distribution: Suggested credit distribution of Electrical and Electronic Engineering program is

S.No.	Course Work - Subject Area	Suggested Credit Distribution Credits	%
1	Humanities and Social Sciences *(HSS)*, including Management;	20	11.4
2	Basic Sciences*(BS,)* including Mathematics, Physics, Chemistry, Biology;	28	16.0
3	Engineering Sciences *(ES),* including Materials, Workshop, Drawing, Basics of Electrical/ Electronics/ Mechanical/ Computing and Instrumentation	26	14.8
4	Professional Subjects-Core *(PSC)*	57	32.6
5	Professional Subjects – Electives *(PSE)*, relevant to the chosen specialization/ branch;	18	10.3
6	Open Subjects- Electives *(OSE)*, from other technical and/or emerging subject areas;	9	5.2

7	Project Work, Seminar and/or Internship in Industry or elsewhere.	17	9.7
	Total	175	

The mandatory non-credit courses, performance in which is not taken into consideration for determining CGPA, include

- Constitution
- Sensitivity to Environment
- Professional Communication
- Professional Ethics

However, if these issues are addressed through other courses, there is no need to separately offer them as non-credit courses.

The program emphasizes active learning and directly addresses some of the outcomes which were hitherto addressed only indirectly. Students undertake three mini projects besides the major project in the final semester. The program outcomes 6 – 12 are directly addressed through courses specifically designed, and through designing and conducting all courses in the framework of Instructional Systems Design model ADDIE. The specially designed courses include a set of courses that address society – technology interface and interaction from which every student is required to take two courses.

Students are introduced to Engineering Systems, specific to each branch, in a course offered at the third semester. This course presents a wide range of case studies, and identifies the key concepts of electrical and electronics engineering while familiarizing with the state of the industry.

8. Course Structure

		L:T:P	**Credits**
Humanities and Social Sciences		**18 (17:0:3)**	
1.	English	2:0:1	3
2.	Professional Communication	1:0:2	3
3.	Organizations	3:0:0	3
4.	Economic Citizenship	3:0:0	3
5.	Energy and Entropy	3:0:0	3
6.	Complexity	3:0:0	3
7.	Constitution and Ethics	2:0:0	2
Basic Sciences		**28 (21:4:3)**	
1.	Engineering Physics	3:0:1	4
2.	Engineering Chemistry	3:0:1	4
3.	Problem Solving through Programming	3:0:1	4
4.	Ordinary Differential Equations	3:1:0	4
5.	Statistics	3:1:0	4
6.	Functions of Several Variables	3:1:0	4

		L:T:P	Credits
7.	Numerical Methods and Partial Differential Equations	3:1:0	4
Engineering Sciences		**34(28:2:4)**	
8.	Workshop	0:0:1	1
9.	Engineering Drawing	1:0:2	3
10.	Ecology and Environment	3:0:0	3
11.	Measurements and Instrumentation	3:0:1	4
12.	Engineering Materials	3:0:0	3
13.	Electrical Engineering Systems	3:0:0	3
14.	Electronic and Communication Systems	3:0:0	3
15.	Mechanical Engineering Systems	3:0:0	3
16.	Civil Engineering Systems	3:0:0	3
17.	Electromagnetics	3:1:0	4
18.	Linear Electrical Networks	3:1:0	4
Professional Subject Core		**57(45:0:12)**	
1.	Analog Circuits and Systems	3:0:1	4
2.	Functional Design of Digital Systems	3:0:1	4
3.	Microcontrollers and Microprocessors	3:0:1	4
4.	Signal Processing	3:0:1	4
5.	Power Supplies and Power Amplifiers	3:0:1	4
6.	Electrical Drives	3:0:1	4
7.	Control Systems	3:0:1	4
8.	Transformers and DC Machines	3:0:1	4
9.	Induction and Synchronous Machines	3:0:1	4
10.	Transmission and Distribution	3:0:0	3
11.	Power System Analysis 1	3:0:1	4
12.	Power System Analysis 2	3:0:1	4
13.	Switchgear and Protection	3:0:0	3
14.	High Voltage Engineering	3:0:1	4
15.	Smart Grid Operation and Management	3:0:0	3
Project		**17 Credits**	
1.	Miniproject - 1		2
2.	Miniproject - 2		2
3.	Miniproject - 3		2
Professional Subject Electives		**18 Credits**	
1.	Digital Control Systems	3:0:0	3
2.	Digital Signal Processing	3:0:0	3

		L:T:P	Credits
3.	Designing with PLDs and FPGAs	3:0:0	3
4.	Embedded Systems Design	3:0:0	3
5.	Design of Electrical Machines	3:0:0	3
6.	Solar Energy Systems	3:0:0	3
7.	Design of VLSI Circuits	3:0:0	3
8.	HV DC Transmission	3:0:0	3
9.	Over Voltages in Power Systems	3:0:0	3
10.	SCADA Systems	3:0:0	3
11.	Power Quality and Control	3:0:0	3
12.	Insulation Engineering	3:0:0	3
13.	Flexible AC Transmission Systems	3:0:0	3
Open Electives			
1.	Operations Research	2:0:0	2
2.	Neural Networks	2:0:0	2
3.	Energy Policy	2:0:0	2

COURSE STRUCTURE FOR FOUR YEAR B.TECH DEGREE PROGRAMME

2012-13 Batch

Department of Electrical and Electronics Engineering

S No	Course Title	L	T	P	Credits
I Semester					
1	English	2	0	1	3
2	Maths 1:Ordinary Differential Equations	3	1	0	4
3	Engineering Physics	3	0	1	4
4	Problem Solving through Programming	3	0	1	4
5	Mechanical Engineering Systems	3	0	0	3
6	Electronics and Communication Systems	3	0	0	3
7	Workshop	0	0	1	1
	Total Credits	17	1	4	22
II Semester					
1	Maths 2:Statistics	3	1	0	4
2	Engineering Chemistry	3	0	1	4
3	Civil Engineering Systems	3	0	0	3
4	Electrical Engineering Systems	3	0	0	3
5	Engineering Drawing	1	0	2	3
6	Minproject				2
	Total Credits	16	1	4	19
III Semester					
1	Functions of Several Variables	3	1	0	4
2	Linear Electrical Networks	3	1	0	4
3	Functional Design of Digital Systems	3	0	1	4
4	Ecology and Environment	3	0	0	3
5	Engineering Materials	3	0	0	3
6	Signal Processing	3	0	1	4
7	Electromagnetics	3	1	0	4
	Total Credits	18	3	2	26
IV Semester					
1	Numerical Methods & PDEs	3	1	0	4
2	Analog Circuits and Systems	3	0	1	4
3	Transformers and DC Machines	3	0	1	4
4	Control Systems	3	0	1	4
5	Energy and Society	3	0	0	3
6	Measurements and Instrumentation	3	0	1	4
7	Miniproject - 2				2
	Total Credits	15	1	3	25

S No	Course Title	L	T	P	Credits
V Semester					
1	Transmission and Distribution	3	0	0	3
2	Power Supplies and Power Amplifiers	3	0	1	4
3	Microcontrollers and Microprocessors	3	0	1	4
4	Induction and Synchronous Machines	3	0	1	4
5	Switchgear and Protection	3	0	0	3
6	Complexity	3	0	0	3
7	Professional Communication	1	0	2	3
	Total Credits	19	0	5	24
VI Semester					
1	Economic Citizenship	3	0	0	3
2	Power System Analysis 1	3	0	1	4
3	Elective – 1	3	0	0	3
4	Elective – 2	3	0	0	3
5	Open Elective 1	2	0	0	2
6	Electrical Drives	3	0	1	4
7.	Constitution and Ethics	2	0	0	2
8	Mini project -2				2
	Total Credits	18	0	4	23
VII Semester					
1	Organizations	3	0	0	3
2	Power Systems Analysis 2	3	0	1	4
3	High Voltage Engineering	3	0	1	4
4	Smart Grid Operation and Management	3	0	0	3
5	Elective – 3	3	0	0	3
6	Elective – 4	3	0	0	3
7	Open Elective 2	2	0	0	2
8	Project Ph1				2
	Total Credits	15	0	2	24
VIII Semester					
1	Elective – 5	3	0	0	3
2	Elective – 6	3	0	0	3
3	Open Elective 3	2	0	0	2
4	Project				9
	Total Credits	9	0	0	17