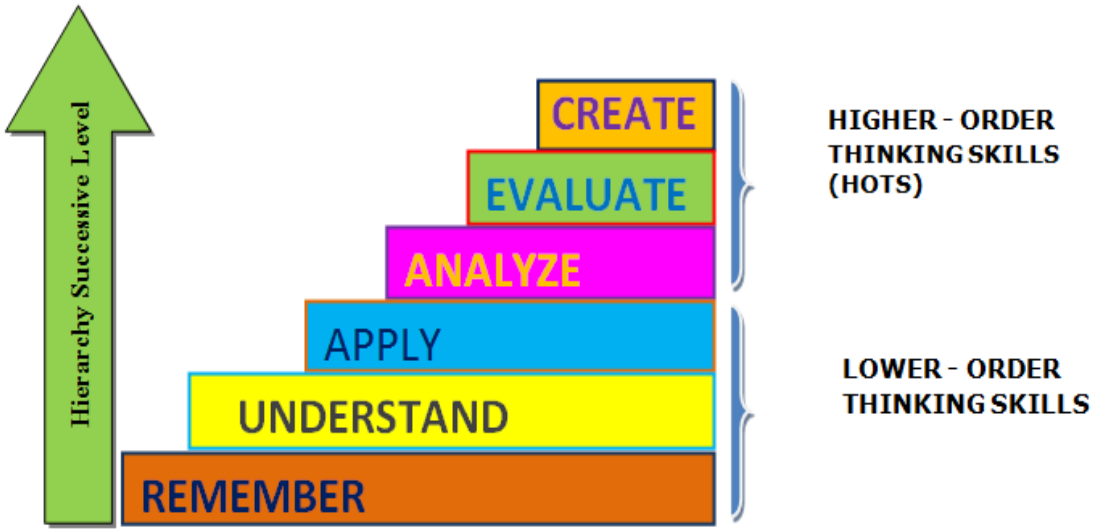
OUTCOME BASED EDUCATION BOOKLET

B.Tech

ELECTRICAL AND ELECTRONICS ENGINEERING

For the Batch of Students admitted during

Academic Year 2018-19



BLOOM'S TAXONOMY OF LEARNING OUTCOMES

.....Moving Towards Perfection in Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Approved by AICTE; Affiliated to JNTUH and Accredited by NAAC with 'A' Grade
Dundigal, Hyderabad - 500 043

VISION & MISSION

VISION

To produce comprehensively trained, socially responsible, innovative electrical engineers and researchers of high quality who can contribute for the nations and global development.

MISSION

The mission of Electrical and Electronics Engineering is to provide academic environment with a strong theoretical foundation, practical engineering skills, experience in interpersonal communication and teamwork along with emphasis on ethics, professional conduct and critical thinking. Further, the graduates will be trained to have successful engagement in research and development and entrepreneurship.

Contents
Program Education Objectives and Outcomes

As Per NBA Norms Post June, 2015

Semester: I-I,I-II, II-I, II-II, III-I, III-II, IV-I & IV-II

Part - I

PROGRAM EDUCATIONAL OBJECTIVES AND OUTCOMES

First version 22 July, 2014

Program Educational Objectives, Program Outcomes and Assessment Criteria (Approved by BOS EEE on 24/1/2015):

Electrical and Electronics Engineering Board Of Studies (EEEBOS):

The Electrical and Electronics Engineering Board Of Studies (EEEBOS) is composed from a diverse group of representatives from academe, industry and importantly the alumni. The "Program Educational Objectives**"** were initially drafted by a committee of EEE faculty and were vetted and approved by a group of faculty from peer department, Electrical And Electronics Engineering. Assessment data for evaluation of effectiveness of the program and achievement of program objectives is collected annually through "alumni surveys" and every three years through "employer surveys". This information is compiled by departmental committee and presented to EEE department.

External Advisory Board for review. The feedback and recommendation of EEE Board are implemented for improvements year on year. The meeting of Board members is conducted annually. Additional meetings are conducted as required, to review strategic planning and innovative programs for their impact on programs. The Board members visits the institute and holds meeting with representatives of administration, faculty and the students. The secretary of departmental Board presents a report to the council, on improvements and amendments to the program. The Board Of Studies prepares a status report for action and review by the Principal.

B. Tech - Electrical and Electronics Engineering Program

The Electrical and Electronics Engineering department at the institute is dedicated to providing educational opportunities in Electrical and Electronics Engineering to specific undergraduate student body of talented girls and boys. The department emphasizes close interactions between students and the faculty dedicated to education and actively engaged in events enriching the educational programs. The program emphasizes active learning with a strong laboratory component. The department nurtures the intellectual, professional, and personal development of students with a view to transform them to competent professionals and responsible members of the society.

1. PROGRAM EDUCATIONAL OBJECTIVES, OUTCOMES AND ASSESSMENT CRITERIA

Learning Outcomes, Assessment Criteria:

The **educational objectives** of a module are statements of the broad intentions of the teaching team. They indicate what the teaching team intends to cover and the learning opportunities they intend to make available to student. A **learning outcome** is a statement of what a learner (student) is expected to know, understand and /or be able to do at the end of learning period. The department prefers to express learning outcomes with following common prefix:

'On completion of course (the period of learning e.g. module), the student is expected to be able to…'
Generally, learning outcomes do not specify curriculum, but more general areas of learning. It is not possible to prescribe precisely how specific a learning outcome statement should be. A balance is

struck between the degree of specificity in a learning outcome statement and that achieved by the assessment criteria, below. On one hand too many learning outcomes, for a module, are considered akin to assessment criteria or curricular detail (EEE intend to describe the curriculum in a range statement) while too few learning outcomes fail to provide sufficient information on the course. As a practice between 3 and 6 learning outcomes are considered by the department for a course.

The Program Educational Objectives (PEOs) of the Electrical and Electronics Engineering department are broad statements or road maps describing career and professional objectives we intend our graduates to achieve through this program.

2. B. TECH - ELECTRICAL AND ELECTRONICS ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES

Program Educational Objective - I

To provide students with the knowledge of Basic Sciences in general and Electrical and electronics Engineering in particular so as to acquire the necessary skills for analysis and synthesis of problems in generation, transmission and distribution.

Program Educational Objective - II

To provide technical knowledge and skills to identify, comprehend and solve complex tasks in industry and research and inspire the students to become future researchers / scientists with innovative ideas.

Program Educational Objective - III

To prepare the students for successful employment in various Industrial and Government organizations, both at the National and International level, with professional competence and ethical administrative acumen so as to handle critical situations and meet deadlines.

Program Educational Objective - IV

To train the students in basic human and technical communication skills so that they may be good team-members, leaders and responsible citizen With a view to challenge ourselves and to nurture diverse capabilities for professional and intellectual growth for our graduates it is important for the department to define departmental objectives in generalized and broad format. Adherence to these objectives is proposed to be demonstrated through actions or achievements.

I. Following indicators are considered as demonstration of (success in Electrical and Electronics Engineering areas / other allied and diverse fields):

a. Acceptance and satisfactory progress by students in a graduate degree program.
b. Significantly contributing and delivery of desired engineering component, product or process.
c. Formulating and solving, moderately complex electrical and electronics engineering problems.
d. Skillful use of state-of-the-art tools for electrical and electronics engineering processes.
e. Making practical recommendations that address issues related to Electrical and Electronics Engineering product and systems.
f. Producing clear written electrical and electronics engineering documentation (papers, reports, and significant parts of proposals).
g. Being assigned to make reports or presentations for internal or external clients.
h. Publishing and reviewing papers for conferences / journals, or producing an internally reviewed publication.

i. Making a significant contribution to a proposal.

j. Making a useful invention and drafting/ applying for a patent.

k. Participating in the field through; public speaking, activity in professional societies/ technical associations etc.

l. Addressing issues related to intellectual property rights.

m. Capability to handle societal, ethical, legal, business and technical issues related to a project.

II. Contribute and excel in their fields or professions, develop professional ethics and leadership qualities may be demonstrated by any of the following:

a. Leading a project or designed team.

b. Promotion to managerial position.

c. Election or appointment to leadership position in a professional society.

d. Participating in one of the organization's NSS programs.

e. Volunteering in a college, civic or other charitable organization.

f. Participating in team sports or coaching.

g. Effectively handling a situation involving ethics

III. Professional attitude, effective communication skills, capabilities to succeed in multi-disciplinary or diverse fields may be demonstrated by any of the following:

a. Appropriately using tools for collaboration, such as telecoms, Videocon's etc.

b. Skillfully using tools for project and configuration management, like resource planning systems, software source control systems, etc.

c. Working successfully on ethnically, technically and gender diverse teams.

d. Effectively resolving problems encountered in team work.

e. Communicating effectively in a group environment.

f. Estimating correctly the required resources (time, team, equipment etc.) for Electrical and Electronics Engineering projects.

g. Making appropriate decisions on outsourcing and developing components in-house.

h. Seeking assistance or elevating problems when necessary.

IV. Continue to pursue professional development including continuing or advanced education relevant to their career growth and to create enthusiasm for sustained life-long learning may be demonstrated by any of the following:

a. Successfully completing the graduate course.

b. Self-learning; a new skill, tool, area system.

c. Reading technical books, journals, conference papers, technical reports or standards.

d. Attending a technical conference, symposium or workshop.

e. Belonging to a professional society.

The department of Electrical and Electronics Engineering periodically reviews these objectives and as part of this review process, encourages comments from all interested parties including current students, alumni, prospective students, faculty, teaching assistants, those who hire or admit our graduates to other programs, members of related professional organizations, and colleagues from other educational institutions.

3. B. TECH – ELECTRICAL AND ELECTRONICS ENGINEERNIG PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

A graduate of the Electrical and Electronics Engineering Program Outcomes will demonstrate:

GENERAL PROGRAM OUTCOMES (POs)

PO - 1: **Engineering Knowledge**:

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

PO - 2: **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.

PO - 3: **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

PO - 4: **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.

PO - 5: **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.

PO - 6: **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

PO - 7: **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.

PO - 8: **Ethics**:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO - 9: **Individual and Team Work**:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO - 10: **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.

PO - 11: **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.

PO - 12: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)

PSO - 1:
Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based teamwork.

PSO - 2:
Can explore the scientific theories, ideas, methodologies and the new cutting edge Technologies in renewable energy engineering, and use this erudition in their professional envelopment and gain sufficient competence to solve the current and future energy problems universally.

PSO - 3:
The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

4. MAPPING OF PROGRAM EDUCATIONAL OBJECTIVES TO PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

The following Figure shows the correlation between the PEOs and the POs

PEO-I	PEO-II	PEO-III	PEO-IV
PO: 1, 2, 3, 4, 5, 6, 7, 11, 12	**PO**: 1, 2, 3, 4, 5, 6, 8, 9, 10, 11	**PO**: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12	**PO**: 6, 7, 8, 9, 10, 11, 12

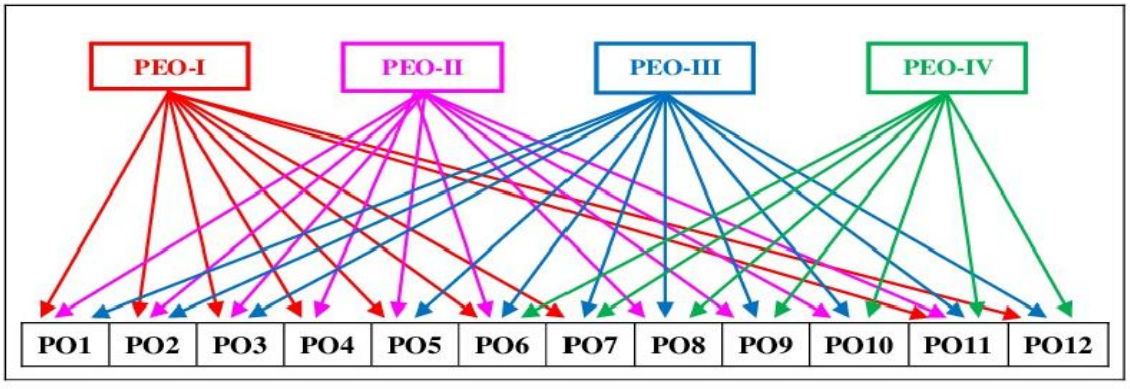


Figure: Correlation between the PEOs and the POs

The following Figure shows the correlation between the PEOs and the PSOs

PEO-I	PEO-II	PEO-III	PEO-IV
PSO: 1, 2	**PSO**: 1,3	**PSO**: 1,2,3	**PSO**: 2,3

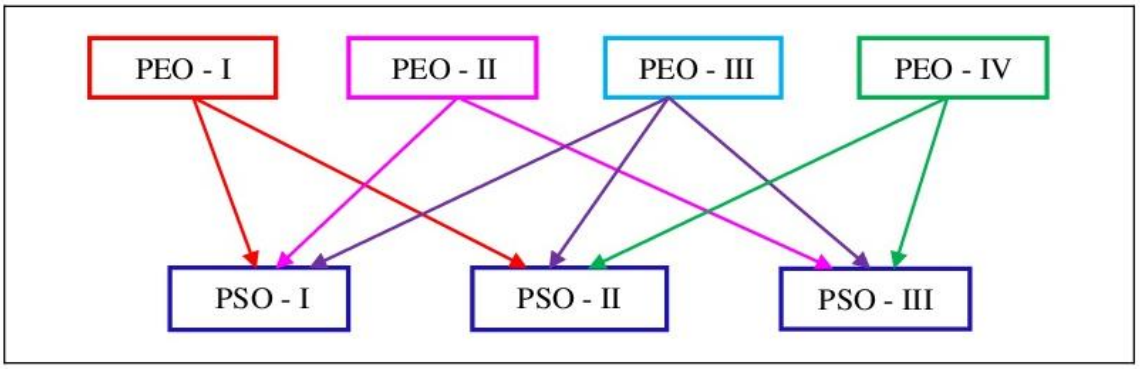


Figure: The correlation between the PEOs and the PSOs

The following Tables shows the correlation between the Program Educational Objectives and the Program Outcomes& Program Specific Outcomes

S. No	Program Educational Objectives	Program Outcomes
I	**Success in Electrical Engineering area**	**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. **PO - 6**: **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 **PO - 7**: **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. **PO - 11**: **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. **PO - 12: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
II	**Industrial awareness and research**	**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. **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: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.
III	**Successful employment and professional ethics**	**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. **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: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. **PO12: 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.
IV	**Being an leader professional and societal environment**	**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: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. **PO12: 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.

S. No	Program Educational Objectives	PSO'S
I	**Success in Electrical Engineering area**	**PSO-1**: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work. **PSO - 2**: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional envelopment and gain sufficient competence to solve the current and future energy problems universally.
II	**Industrial awareness and research**	**PSO-1**: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work. **PSO-3**:The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications
III	**Successful employment and professional ethics**	**PSO-1**: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work. **PSO- 2**: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional envelopment and gain sufficient competence to solve the current and future energy problems universally. **PSO-3**:The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

IV	**Being an leader professional and societal environment**	**PSO-2**: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional envelopment and gain sufficient competence to solve the current and future energy problems universally. **PSO-3**:The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

5. RELATION BETWEEN THE PROGRAM EDUCATIONAL OBJECTIVES AND THE PROGRAM OUTCOMES, PROGRAM SPECIFIC OUTCOMES:

Broad relationship between the program objectives and the program outcomes is given in the Following Table Below:

Program Educational Objectives (PEOs) / Program Outcomes (POs)		I	II	III	IV
		Success in Electrical Engineering Fields	**Industrial awareness and research**	**Successful employment and professional ethics**	**Being an leader professionally and societal environment**
PO-1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	**3**	**3**	**3**	**2**
PO-2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	**3**	**3**	**2**	**2**
PO-3	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.	**3**	**3**	**2**	**2**
PO-4	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.	**3**	**3**	**2**	**2**
PO-5	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.	**3**	**3**	**2**	**2**
PO-6	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.	**2**	**3**	**3**	**3**

PO-7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	**2**	**2**	**3**	**3**
PO-8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**2**	**2**	**3**	**3**
PO-9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	**2**	**3**	**3**	**3**
PO-10	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.	**2**	**3**	**3**	**3**
PO-11	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.	**2**	**3**	**3**	**3**
PO-12	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.	**2**	**2**	**3**	**3**
Relationship between Program Outcomes and Program Educational Objectives **Key: 3 = Highly Related; 2 = Medium; 1= Low**					

RELATION BETWEEN THE PROGRAM SPECIFIC OUTCOMES AND THE PROGRAM EDUCATIONAL OBJECTIVES

Program Educational Objectives (PEOs) **Program Specific Outcomes (PSOs)**		**I**	**II**	**III**	**IV**
		Success in Electrical Engineering Fields	**Industrial awareness and research**	**Successful employment and professional ethics**	**Being an leader professionally and societal environment**
PSO-1	Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	**2**	**3**	**3**	**2**

PSO-2	Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional envelopment and gain sufficient competence to solve the current and future energy problems universally.	**3**	**2**	**3**	**2**
PSO-3	The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications	**2**	**2**	**2**	**3**
Relationship between Program Specific Outcomes and Program Educational Objectives Key: 3 = Highly Related; 2 = Medium; 1= Low					

Note:

- The assessment process can be direct or indirect.
- The direct assessment will be through interim assessment by the faculty or by industry / technology experts.
- The indirect assessment on the other hand could be by students through course outcomes, lab evaluation, department associations, exit interviews, engineering services, GATE etc.
- Frequency of assessment can be once in a semester and justified by the program coordinator

6. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMESOF (B. Tech) EEE GRADUATES

Graduates from accredited program must achieve the following learning outcomes, defined by Broad areas of learning. The outcomes are distributed within and among the courses within our curriculum, and our students are assessed for the achievement of these outcomes, as well as specific course learning objectives, through testing, surveys, and other faculty assessment instruments. Information obtained in these assessments is used in a short-term feedback and improvement loop

PO–1; Engineering knowledge: Apply the knowledge of mathematics, science, engineering Fundamentals and an engineering specialization to the solution of complex engineering Problems.

Performance Criteria Definitions:

- Knowledge and understanding of scientific principles and methodology necessary to strengthen their education in their engineering discipline, to enable appreciation of its scientific and engineering context and to support their understanding of historical, current and future developments and technologies
- Knowledge and understanding of mathematical principles necessary to underpin their education in their engineering discipline and to enable them to apply mathematical problems
- Ability to apply and integrate knowledge and understanding of other engineering disciplines to support the study of their own engineering discipline.

PO–2: 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.**

Performance Criteria Definitions:

Practical application of engineering skills through combining theory and experience Use of other relevant knowledge and skills in fulfilling this objective, including:

- Knowledge of material characteristics, equipment, processes, or products
- Workshop and laboratory skills
- Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology development, etc.)
- Understanding use of technical literature and other sources of information
- Awareness of nature of intellectual property and contractual issues
- Understanding of appropriate codes of practice and industry standards
- Awareness of quality issues
- Ability to work with technical uncertainty
- Understanding of engineering principles and ability to apply them to analyze key engineering processes
- Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques
- Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems
- Understanding ability to apply a systems approach to engineering problems

PO-3: 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**

Performance Criteria Definitions:

Design is the creation and development of an economically viable product, process or system to meet a defined application. It involves significant technical and intellectual skills that can be used, to integrate all engineering understanding, knowledge for the solution of real problems. Graduates will therefore need the knowledge, understanding and skills to:

- Investigate and define a problem and identify constraints relating to health, safety, environmental and sustainability and assessment of risks based on these constraints.
- Understand customer and user needs and the importance of considerations such as aesthetics
- Identify and manage costs and drivers thereof.
- Use creativity to establish innovative solution Ensure fitness of purpose, for all aspects of the problem including production, operation, maintenance and disposal
- Manage the design process and evaluate outcomes.
- Knowledge and understanding of commercial and economic context of engineering Processes.
- Knowledge of management techniques which may be used to achieve engineering objectives within that context.
- Understanding of the requirement for engineering activities to promote sustainable development.
- Awareness of the framework of relevant legal requirements governing engineering activities including personnel, health, safety and Environmental (HSE) risks.

PO–4: 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.

Performance Criteria Definitions:

- Problem or opportunity identification.
- Problem formulation and abstraction.
- Information and data collection.
- Model translation.
- Experimental design and solution development.
- Implementation and documentation.
- Interpretation of results.

As the most engineers eventually learn, the problem solving process is never complete. Therefore, a final element here is feedback and improvement.

PO-5: 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

Performance Criteria Definitions:

- Encompasses a wide range of tools and skills needed by engineering graduates in computer software, simulation packages, diagnostic equipment, use of technical library resources and literature search tools.

PO-6: 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.

Performance Criteria Definitions:

- Ability to make informed ethical choices and knowledge ability to of professional codes of ethics. Evaluates the ethical dimensions of professional practice and demonstrates ethical behavior.
- High degree of trust and integrity

PO-7: 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.

Performance Criteria Definitions:

- Focusing the knowledge and interpretation a socio economic, political and environmental issues.
- Obtaining in-depth knowledge on contemporary issue.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. Create a plan for success that connects their college education to future career.

Performance Criteria Definitions:

- Graduates ready for immediate employment.
- Make a smooth transition into post graduate studies

PO - 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Performance Criteria Definitions:

- Maturity – requiring only the achievement of goals to drive their performance.

- Self-direction (take a vaguely defined problem and systematically work to resolution).
- Teams are used during the classroom periods, in the hands-on labs and in the design projects.
- Some teams change for eight-week industry oriented Mini-Project, and for the seventeen –week Design project.
- Instruction on effective teamwork and project management is provided along with an appropriate text book for reference.
- Teamwork is important not only for helping the students and to know their classmates but also in completing assignments.
- Students also are responsible for evaluating each other's performance, which is then reflected in the final grade.
- Ability to demonstrated and work with all levels of people an a team in organization.

PO -10: 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.

Performance Criteria Definitions

I. **Written Communication: "**Students should demonstrate the ability to communicate effectively in writing".
   - Clarity.
   - Grammar/Punctuation
   - References

II. **Verbal Communication:** "Students should demonstrate the ability to communicate effectively orally."
   - Speaking Style.
   - Subject Matter.

PO -11: 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.

Performance Criteria Definitions:

Inspire the students to further explore in his/her program to recognize the need for life-long Learning. Some aspects of life-long learning include:

- Knowledge and understanding of commercial and economic context of engineering processes.
- Knowledge of managerial techniques which may be used to achieve engineering objectives within that context.
- Understanding of the requirement for engineering activities to promote sustainable development.
- Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.
- Personal continuing education efforts.
- Understanding of the need for a high level of professional and ethical conduct in engineering.

PO-12: 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.

Performance Criteria Definitions:

- Project management professional certification.

- Begin work on advanced degree.
- Updating the knowledge, related to advanced electrical engineering concepts.
- Personal continuing education efforts.
- Ongoing learning – stays up with industry trends/ new technology.
- Continued personal development.
- Have learned same new significant skills.
- Have taken up to 80 hours training per year.

PROGRAM SPECIFIC OUTCOMES OF (B. Tech) EEE GRADUATES

Graduates from accredited program must achieve the following learning outcomes, defined by Broad areas of learning.

PSO-1: Problem-Solving Skills: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based

Performance Criteria Definitions:

- Limits on type of transmission can be understood.
- The insulation technology plays major rule in high voltage engineering.
- The process of ionization majority contributed to the power system.
- The new techniques can be evolved for the generation of high voltage.
- The curiosity towards material science will step ahead.

PSO-2: Professional Skills: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their Professional development and gain sufficient competence to solve the current and future energy problems universally.

Performance Criteria Definitions:

- One can work on the resources used to generate electricity.
- Can compare the different electricity generating sources.
- Can works toward the new concept called is distribution generation.
- The scope for installing mini - scale individual power plant can be increases.
- The vision of rural power development increase.
- Ultimately the research work towards developed nation can increase.

PSO-3: Modern Tools In Electrical Engineering: The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

Performance Criteria Definitions:

- The real time automation techniques required.
- The design analysis, installation and testing of power system components can be made easy automation techniques.
- Good grip on automation electrical system lags the path per good opportunities for carrier.
- In the Entrepreneurship point of view, nowadays must be the electrical application or automated, this leads to individual entrepreneurship.
- The automation mission interface increase scope of research and developing by deferent application.

Faculty Objectives:

F1: Prepare graduates for personal and professional success with awareness of and commitment to their ethical and social responsibilities, both as individuals and in team environments.

F2: Enable graduates to keep on self- development throughout their careers.

F3: Produce graduates with the necessary background and technical skills to work professionally and fulfill the need of industry.

F4: Organize, in collaboration with stakeholders, conferences, symposia and workshops to upgrade technical and scientific levels in Electrical and Electronic Engineering

F5: Carry out and publish academic knowledge.

F6: Activities to promote research innovation, commercialization and Entrepreneurship Increase.

Program Outcomes and Program Specific outcomes Attained through course modules:

Courses offered in Electrical and Electronics Engineering Curriculum IARE-R18) –Vs- Program Outcomes and Program Specific Outcomes Attained through course modules for I-I,I-II Semesters

I Semester B.Tech															
Code	Subject	PO											PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
AHSB01	English									X	X		X		X	
AHSB02	Linear Algebra Calculus	X	X											X		
AHSB03	Engineering Chemistry	X	X		X			X						X		
AHSB08	English Language Communication Skills Laboratory										X	X	X		X	
AHSB09	Engineering Chemistry Laboratory	X	X		X			X						X		
AMEB02	Engineering Graphics And Design Laboratory	X	X	X		X				X	X	X		X	X	
II Semester B.Tech																
AHSB11	Mathematical Transform Techniques	X	X		X									X		
AHSB04	Waves And Optics	X	X		X									X		
ACSB01	Programming For Program Solving	X	X	X		X						X		X	X	X
AEEB03	Electrical Circuits	X	X	X			X							X	X	
ACSB02	Programming For Program Solving Laboratory	X	X	X		X						X		X	X	X
AHSB10	Engineering Physics Laboratory	X	X		X									X		
AEEB07	Electrical Circuits Laboratory	X	X	X			X							X	X	
AMEB01	Workshop/Manufacturing Practices Laboratory										X	X	X		X	

7. PROCEDURES FOR OUTCOME DELIVERY AND ASSESSMENT WITH RESPECT TO PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Code	Subject	Code	Subject
PO1: **Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**			
I Semester & II Semester			
AHSB02	Linear Algebra Calculus	AHSB09	Engineering Chemistry Laboratory
AHSB03	Engineering Chemistry	AMEB02	Engineering Graphics And Design Laboratory

Code	Subject	Code	Subject
AHSB11	Mathematical Transform Techniques	AEEB03	Electrical Circuits
AHSB04	Waves And Optics	ACSB02	Programming For Program Solving Laboratory
ACSB01	Programming For Program Solving	AHSB10	Engineering Physics Laboratory
AEEB07	Electrical Circuits Laboratory		

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.

I Semester & II Semester

AHSB02	Linear Algebra Calculus	AHSB09	Engineering Chemistry Laboratory
AHSB03	Engineering Chemistry	AMEB02	Engineering Graphics And Design Laboratory
AHSB11	Mathematical Transform Techniques	AEEB03	Electrical Circuits
AHSB04	Waves And Optics	ACSB02	Programming For Program Solving Laboratory
ACSB01	Programming For Program Solving	AHSB10	Engineering Physics Laboratory
AEEB07	Electrical Circuits Laboratory		

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.

I Semester & II Semester

AMEB02	Engineering Graphics And Design Laboratory	ACSB01	Programming For Program Solving
AEEB07	Electrical Circuits Laboratory	AEEB03	Electrical Circuits
ACSB02	Programming For Program Solving Laboratory		

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.

I Semester & II Semester

AHSB03	Engineering Chemistry	AHSB09	Engineering Chemistry Laboratory
AHSB11	Mathematical Transform Techniques	AHSB10	Engineering Physics Laboratory
AHSB04	Waves And Optics		

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.

I Semester & II Semester

AMEB02	Engineering Graphics And Design Laboratory	ACSB01	Programming For Program Solving
ACSB02	Programming For Program Solving Laboratory		

Code	Subject	Code	Subject
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.**			
I Semester & II Semester			
AEEB03	Electrical Circuits	AEEB07	Electrical Circuits Laboratory
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.**			
I Semester & II Semester			
AHSB03	Engineering Chemistry	AHSB09	Engineering Chemistry Laboratory
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.**			
I Semester & II Semester			
AHSB01	English	AMEB02	Engineering Graphics And Design Laboratory
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.**			
I Semester & II Semester			
AHSB01	English	AHSB08	English Language Communication Skills Laboratory
AHSB02	Linear Algebra Calculus	AMEB01	Workshop/Manufacturing Practices Laboratory
PO11: **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.**			
I Semester & II Semester			
AHSB08	English Language Communication Skills Laboratory	AMEB02	Engineering Graphics And Design Laboratory
ACSB01	Programming For Program Solving	ACSB02	Programming For Program Solving Laboratory
AMEB01	Workshop/Manufacturing Practices Laboratory		
PO12: **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.**			
I Semester & II Semester			
AHSB01	English	AHSB08	English Language Communication Skills Laboratory
AMEB01	Workshop/Manufacturing Practices Laboratory		

The classification of Program Specific outcomes of the above Electrical and Electronics Engineering Courses are grouped as follows:

PSO1:
Professional Skills: Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based.

Code	Subject	Code	Subject
I Year		III B.Tech I Semester	
AHSB02	Linear Algebra Calculus	AHSB11	Mathematical Transform Techniques
AHSB03	Engineering Chemistry	AHSB04	Waves And Optics
ACSB01	Programming For Program Solving	AHSB10	Engineering Physics Laboratory
AEEB03	Electrical Circuits	AEEB07	Electrical Circuits Laboratory
ACSB02	Programming For Program Solving Laboratory		

PSO2:
Problem-Solving Skills: Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.

Code	Subject	Code	Subject
I Year			
AHSB01	English	AHSB08	English Language Communication Skills Laboratory
AMEB02	Engineering Graphics And Design Laboratory	ACSB01	Programming For Program Solving
AEEB07	Electrical Circuits Laboratory	AEEB03	Electrical Circuits
AMEB01	Workshop/Manufacturing Practices Laboratory	ACSB02	Programming For Program Solving Laboratory

PSO3:
Successful Career and Entrepreneurship: The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

Code	Subject	Code	Subject
I Year			
ACSB01	Programming For Program Solving	ACSB02	Programming For Program Solving Laboratory

8. METHODSOFMEASURINGLEARNINGOUTCOMESANDVALUEADDITION:

There are many different ways to assess student learning. In this section, we present the different types of assessment approaches available and the different frame works to interpret the results.

i. Mid Semester Course Evaluation
ii. End-of Semester Course Evaluation
iii. Continuous Evaluation of Classroom Performance
iv. Course Objective Surveys
v. Course Instructor's Evaluations
vi. Graduating Senior's survey
vii. Alumni Survey
viii. Employer Survey
ix. Laboratory and Project Works

x. Balanced Composition in Curriculum
xi. Department Academic Committee and Faculty Meetings
xii. Professional Societies

The above assessment indicators are detailed below.

i. Mid Semester Course Evaluation

Mid semester course reviews are conducted for all courses by the department. All students are encouraged to actively participate in this evaluation process. These evaluations are critically reviewed by HOD and senior faculty and the essence is communicated to the faculty concerned to analyze, improve and practice so as to improve the performance of the student.

ii. End-of Semester Course Evaluation

The end-of semester course reviews are conducted, feedback taken from students and remedial measures will be taken up such that the student gets benefited before going for the university end exams. The positive and negative comments made by the students about the course are recorded and submitted to the departmental academic council (DAC) and to the Principal for taking necessary actions to better the course for subsequent semesters.

iii. Continuous Evaluation of Classroom Performance

Students are encouraged and motivated to participate actively in the classroom proceedings by way of interactive teaching by the instructor. Surprise class tests comprising of short answer questions, quiz based discussions, multiple-choice, true-false, and matching tests are conducted to strengthen the teaching-learning process. Apart from teacher control and covering content, the teacher also act a safe licitator and students discover things for themselves, enabling them to be more independent and becoming life – long learners exploring student-centric educational philosophy.

iv. Course Objective Surveys

Students are encouraged to fill-out a brief survey on the fulfillment of course objectives. The data is reviewed by the concerned course faculty and the results are kept open for the entire faculty. Based on this, alterations or changes to the course objectives are undertaken by thorough discussions in faculty and DAC meetings.

v. Course Instructor's Evaluations

The course coordinator will collect the course port folios from there spective instructors of each course offered in a given semester at the beginning of the semester as well as at the end of the semester. They remain on file for verification and study by the entire faculty. This helps the course coordinator and faculty to understand how effectively we can teach the given course. Betterment can be achieved from time to time and continuous improvement can be shown in handling courses in the subsequent semesters.

vi. Graduating Senior's Survey

The graduating seniors survey form is to be filled by all the students leaving the institution. The questionnaire is designed in such away to gather information from the students regarding the program educational objectives, solicit about program experiences, carrier choices, as well as any suggestions and comments for the improvement of the program. The

opinions expressed in exit interview forms are reviewed by the DAC for implementation purposes.

vii. Alumni Survey

The survey asks former students of the department about the status of their employment and further education, perceptions of institutional emphasis, estimated gains in knowledge and skills, involvement a sunder graduate students, and continuing involvement with Institute of Aeronautical Engineering. This survey is administered every three years. The data obtained will be analyzed and used in continuous improvement.

viii. Employer Survey

The main purpose of this employer questionnaire is to know employer's views about the skills they require of employees compared to the skills actually possessed by them. The purpose e is also to identify gaps in technical and vocational skills, need for required training practices to fill these gaps and criteria for hiring new employees. These employer surveys are reviewed by the College Academic Council (CAC) to affect the present curriculum to suit the requirement so the employer.

ix. Laboratory and Project Works

The laboratory work is continuously monitored and assessed to suit the present demands of the industry. Students are advised and guided to do project works giving solutions to research / industrial problems to the extent possible by the capabilities and limitations of the student. The results of the assessment of the individual projects and laboratory work can easily be conflated in order to provide the students with periodic reviews of their overall progress and to produce terminal marks and grading.

x. Balanced Composition in Curriculum

The undergraduate program in electronics and communication engineering is designed to prepare students for successful careers in engineering and related fields by providing a balanced education, that prepares students to apply analytical, computational, experimental, and methodological tools to solve engineering problems; a strong foundation in mathematics and physical sciences; abroad and balanced general education in the humanities, arts, social sciences, and interdisciplinary studies; sufficient training and development of skills for effective communication and teamwork; a proper understanding of an engineer's professional and ethical responsibilities in relation to engineering fields and society; and recognition of the need for lifelong learning. The student's intellectual and ethical development is assessed continuously in relation to the balanced composition in curriculum.

xi. Department Academic Committee and Faculty Meetings

The DAC meets bi-annually for every academic year to review the strategic planning and modification of PEOs. Faculty meetings are conducted at least once in fortnight for ensuring the implementation of DAC's suggestions and guidelines. All these proceeding are recorded and kept for the availability of all faculties.

xii. Professional Societies

The importance of professional societies like IEEE, IETE, ISTE etc., are explained to the students and they are encouraged to become members of the above to carry out their continuous search for

knowledge. Student and faculty chapters of the above societies are constituted for a better technical and entrepreneurial environment. These professional societies promote excellence in instruction, research, public service and practice.

Part - II

METHODOLOGY FOR PREPARATION AND ASSESSMENT OF COURSE LEVEL STUDENT LEARNING OUTCOMES

Although the term "Expected Learning Outcome" may be new, the process of identifying the key concepts or skills that students are expected to learn during specific courses is not. Many people are more familiar with the terms "course objective" or "course competency". Expected learning outcomes are really very similar to both of these concepts, so if you already have course objectives or competencies, you are close to having expected learning outcomes for class.

This will provide information on exactly what expected learning outcomes are and what methods can be used to assess them. This is designed to assist faculty with the process of developing expected learning outcomes and methods for assessing those outcomes in their courses. This provides basic information related to (1) course purpose; (2) expected learning outcomes; (3) methods for assessing expected learning outcomes; (4) criteria for grade determination; and (5) course outline.

Expected Learning Outcomes:

Learning Outcomes are the formal statements of what students are expected to learn in a course. Synonyms for "learning outcome" include expected learning outcome, learning outcome statement, and student learning outcome. Course level student learning outcomes provide information on exactly what expected learning outcomes are and what methods can be used to assess them. This is designed to assist faculty with the process of developing expected learning outcomes and methods for assessing those outcomes in their courses. This provides basic information related to course purpose, expected learning outcomes, methods for assessing expected learning outcomes, criteria for grade determination and a course outline. After reading and completing this, individuals will be able to:

- Prepare a description of the course as well as a written statement regarding the course's purpose.
- Construct/develop expected learning outcomes for the course.
- Create an assessment plan that outlines the specific methods that will be used to assess the expected student learning outcomes for a course.
- Describe how grades will be determined in a process that is separate and distinct from assessing the expected learning outcomes.
- Identify the common components of a course outline.
- Revise their course syllabi to incorporate a course purpose, expected learning outcomes, methods to assess those outcomes, the criteria for grade determination, and a course outline.
- This process uses some terminology related to expect learning outcomes and assessment. A brief glossary of terms has been provided below for reference purposes.

Assessment of expected learning outcomes:

The process of investigating (1) what students are learning and (2) how well they are learning it in relation to the stated expected learning outcomes for the course.

Assessment plan:

The proposed methods and timeline for assessment-related activities in a given course (e.g., when are you going to check what/how well the students are learning and how are you going to do that?).

Classroom Assessment Technique (CAT):

Angelo and Cross (1993) developed a variety of techniques / activities than can be used to assess students' learning. These CATs are often done anonymously and are not graded. These activities check on the class' learning while students are still engaged in the learning process. An example of a CAT is a non-graded quiz given a few weeks before the first exam.

Course description:

A formal description of the material to be covered in the course

Course purpose:

The course purpose describes the intent of the course and how it contributes to the program. The course purpose goes beyond the course description.

Evaluation

Making a judgment about the quality of student's learning / work and assigning marks based on that judgment Evaluation activities (such as exams, papers, etc.) are often seen as formal ways to assess the expected learning outcomes for a course.

Methods for assessing student learning outcomes:

This term refers to any technique or activity that is used to identify what students are learning or how well they are learning. Formal methods for evaluating student learning outcomes include Continuous Assessment Tests, Mid Semester Test, Tutorials, and End Semester Examination etc. The assessment methods are used to identify how the well students have acquired the learning outcomes for the course.

1. COURSE PURPOSE:

One of the first steps in identifying the expected learning outcomes for a course is identifying the purpose of teaching in the course. By clarifying the purpose of the course, faculty can help discover the main topics or themes related to students' learning. These themes help to outline the expected learning outcomes for the course.

The course purpose involves the following:

1. What role does this course play within the program?
2. How is the course unique or different from other courses?
3. Why should/do students take this course? What essential knowledge or skills should they gain from this experience?
4. What knowledge or skills from this course will students need to have mastered to perform well in future classes or jobs?
5. Why is this course important for students to take?
6. The "Course Description" provides general information regarding the topics and content addressed in the course, the "Course Purpose" goes beyond that to describe how this course fits in to the students' educational experience in the program.

2. EXPECTED LEARNING OUTCOMES:

An expected learning outcome is a formal statement of what students are expected to learn in a course. Expected learning outcome statements refer to specific knowledge, practical skills, areas of professional development, attitudes, higher-order thinking skills, etc. that faculty members expect students to develop, learn, or master during a course (Suskie, 2004). Expected learning outcomes are also often referred to as "learning outcomes", "student learning outcomes", or "learning outcome statements".

Simply stated, expected learning outcome statements describe:

- What faculty members want students to know at the end of the course and
- What faculty members want students to be able to do at the end of the course.

Learning outcomes have three major characteristics

- They specify an action by the students/learners that is **observable**
- They specify an action by the students/learners that is **measurable**
- They specify an action that is done by the **students/learners** (rather than the faculty members)

Effectively developed expected learning outcome statements should possess all three of these characteristics. When this is done, the expected learning outcomes for a course are designed so that they can be assessed (Suskie, 2004)

3 TO DEFINE EFFECTIVE LEARNING OUTCOME STATEMENTS

When writing expected learning outcomes, it is important to use verbs that describe exactly what the learner(s) will be able to *do* upon completion of the course.

Examples of good action words to include in expected learning outcome statements:
Compile, identify, create, plan, revise, analyze, design, select, utilize, apply, demonstrate, prepare, use, compute, discuss, explain, predict, assess, compare, rate, critique, outline, or evaluate

There are some verbs that are unclear in the context of an expected learning outcome statement (e.g., know, be aware of, appreciate, learn, understand, comprehend, and become familiar with). Thesewords are often vague, have multiple interpretations, or are simply difficult to observe or measure (American Association of Law Libraries, 2005). As such, it is best to avoid using these terms when creating expected learning outcome statements.

For example, please look at the following learning outcomes statements:

- The students will understand Electrical Distribution Systems.
- The students will appreciate knowledge discovery from Distribution Automation Techniques.

Both of these learning outcomes are stated in a manner that will make them difficult to assess. Consider the following:

- How do you observe someone “understanding” a theory or “appreciating” Distribution Automation Techniques
- How easy will it be to measure “understanding” or “appreciation”

These expected learning outcomes are more effectively stated the following way:

- The students will be able to identify and describe what techniques are used in Distribution Automation systems.
- The students will be able to identify the characteristics of Classification techniques from other Distribution Automation Techniques.

Incorporating Critical Thinking Skills into Expected Learning Outcomes Statements

Many faculty members choose to incorporate words that reflect critical or higher-order thinking into their learning outcome statements. Bloom (1956) developed a taxonomy outlining the different types of thinking skills people use in the learning process. Bloom argued that people use different levels of

thinking skills to process different types of information and situations. Some of these are basic cognitive skills (such as memorization) while others are complex skills (such as creating new ways to apply information). These skills are often referred to as critical thinking skills or higher-order thinking skills.

Bloom proposed the following taxonomy of thinking skills. All levels of Bloom's taxonomy of thinking skills can be incorporated into expected learning outcome statements. Recently, Anderson and Krathwohl (2001) adapted Bloom's model to include language that is oriented towards the language used in expected learning outcome statements. A summary of Anderson and Krathwohl's revised version of Bloom's taxonomy of critical thinking is provided below.

Definitions of the different levels of thinking skills in Bloom's taxonomy:

1. **Remember** –recalling relevant terminology, specific facts, or different procedures related to information and/or course topics. At this level, a student can remember something, but may not really understand it.

2. **Understand** –the ability to grasp the meaning of information (facts, definitions, concepts, etc.) that has been presented.

3. **Apply** –being able to use previously learned information in different situations or in problem solving.

4. **Analyze** –the ability to break information down into its component parts. Analysis also refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements/arguments.

5. **Evaluate** –being able to judge the value of information and/or sources of information based on personal values or opinions.

6. **Create** –the ability to creatively or uniquely apply prior knowledge and/or skills to produce new and original thoughts, ideas, processes, etc. At this level, students are involved in creating their own thoughts and ideas.

List of Action Words Related to Critical Thinking Skills

Here is a list of action words that can be used when creating the expected student learning outcomes related to critical thinking skills in a course. These terms are organized according to the different levels of higher-order thinking skills contained in Anderson and Krathwohl's (2001) revised version of Bloom's taxonomy.

REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
Count	Associate	Add	Analyze	Appraise	Categorize
Define	Compute	Apply	Arrange	Assess	Combine
Describe	Convert	Calculate	Breakdown	Compare	Compile
Draw	Defend	Change	Combine	Conclude	Compose
Identify	Discuss	Classify	Design	Contrast	Create
Label	Distinguish	Complete	Detect	Criticize	Drive
List	Estimate	Compute	Develop	Critique	Design
Match	Explain	Demonstrate	Diagram	Determine	Devise
Name	Extend	Discover	Differentiate	Grade	Explain

Outline	Extrapolate	Divide	Discriminate	Interpret	Generate
Point	Generalize	Examine	Illustrate	Judge	Group
Quote	Give	Graph	Infer	Justify	Integrate
Read	Examples	Interpolate	Outline	Measure	Modify
Recall	Infer	Manipulate	Point out	Rank	Order
Recite	Paraphrase	Modify	Relate	Rate	Organize
Recognize	Predict	Operate	Select	Support	Plan
Record	Rewrite	Prepare	Separate	Test	Prescribe
Repeat	Summarize	Produce	Subdivide		Propose
Reproduce		Show	Utilize		Rearrange
Select		Solve			Reconstruct
State Write		Subtract			Related
		Translate			Reorganize
		Use			Revise
					Rewrite
					Summarize
					Transform
					Specify

4 TIPS FOR DEVELOPING COURSE LEVEL EXPECTED LEARNING OUTCOMES STATEMENTS:

- Limit the course-level expected learning outcomes to 5 - 10 statements for the entire course (more detailed outcomes can be developed for individual units, assignments, chapters, etc.).
- Focus on overarching or general knowledge and/or skills (rather than small or trivial details).
- Focus on knowledge and skills that are central to the course topic and/or discipline.
- Create statements that are student-centered rather than faculty-centered (e.g., "upon completion of this course students will be able to list the names of all *Distribution Automation Techniques* versus
- "one objective of this course is to teach the names of all *Distribution Automation Techniques.)*
- Focus on the learning that *results* from the course rather than describing activities or lessons in the course.
- Incorporate or reflect the institutional and departmental missions.
- Incorporate various ways for students to show success (outlining, describing, modeling, depicting, etc.) rather than using a single statement such as "at the end of the course, students will know_____ " as the stem for each expected outcome statement.

5. SAMPLE EXPECTED LEARNING OUTCOMES STATEMENTS:

The following depict some sample expected learning outcome statements from selected courses.

Electrical Circuits

At the end of the course, the student should be able to:

- Define basic electrical concepts, including electric charge, current, electrical potential, electrical Power and energy.
- Distinguish the relationship of voltage and current in resistors, capacitors, inductors, and mutual Inductors.
- Differentiate circuits with ideal, independent, and controlled voltage and current sources and able to apply Kirchhoff's voltage and current laws to the analysis of electric circuits.
- Illustrate to apply concepts of electric network topology, nodes, branches, and loops to solve circuit problems, including the use of computer simulation.
- Capable to analyze electrical circuits thermos

Electrical Machines:

Upon completion of this course, the students will be able to:

- Capable to analyze the principle, Construction and operation of a single phase transformer.
- Proficient with the transformer about the No Load and Load Conditions.
- Development of basic skills in design and analysis of the Equivalent Circuit of a Transformer.
- Acquaint with the star-star, delta –delta, star-delta, delta-star connections of a poly phasor transformer.
- Discriminate the principle, construction and operation of a three phase Induction Motor.
- Interpret the different techniques for the speed control of an Induction Motor.
- Interpolate the performance and torque –slip characteristics of an Induction motor.

Power System:

Upon completion of this course, students will acquire knowledge about:

- Analyze the power system structure and interconnected grid system.
- Compare the applications and significance of both conventional and non-conventional sources.
- Proficient in comparison of different types of generating stations.
- Categorize the different types of substations & its layouts.
- Analyze and perform the tasks of correcting the power factor & voltage control.
- Analyze the power generation economic aspects such as load curves & factor governing the power system performance.
- Evaluate the tariff methods & calculations.

Power System Operation and Control:

After completing this course the student must demonstrate the knowledge and ability to:

- Associate and apply the concept and principle of unit commitment and optimal operation of power plants.
- Estimate the interconnection of power systems networks with two or more streams.
- Assess various methods to obtain the economic operation.
- Proficient in load frequency control of single area and two area networks.
- Identify the steady state and dynamic performance of I area LFC and II area LFC.
- Analyze and perform the tasks of modeling the generator, turbine, and speed governor.
- Compute reactive power control in transmission lines and compensation of reactive power.

6. AN OVERVIEW OF ASSESSMENT

According to Palomba and Banta (1999) assessment involves the systematic collection, review, and use of evidence or information related to student learning. Assessment helps faculty understand how well their students understand course topics/lessons. Assessment exercises are often anonymous. This anonymity allows students to respond freely, rather than trying to get the "right" answer or look good. Assessment exercises attempt to gauge students' understanding in order to see what areas need to be re-addressed in order to increase the students' learning.

In other words, assessment is the process of investigating (1) what students are learning and (2) how wellthey are learning it in relation to the stated expected learning outcomes for the course. This process also involves providing feedback to the students about their learning and providing new learning opportunities/strategies to increase student learning.

For example, Dr. PG Shastry initiates a class discussion on material from Chapter One and determines that most students are confused about Topic X. This class discussion served as a method for assessing student learning and helped determine the fact that student learning related to Topic X is somewhat lacking. Dr. PG Shastry now has the opportunity to (1) inform the students that there is some confusion and(2) make adjustments to address this confusion (e.g., ask student to re-read Chapter One, re-lecture over Topic X, etc.). This assessment process helps increase students' learning.

Difference between "evaluation" and "assessment"

Evaluation focuses on making a judgment about student work to be used in assigning marks that express the level of student performance. Evaluation is usually used in the process of determining marks. Evaluation typically occurs after student learning is assumed to have taken place (e.g., a finalexam). Evaluation is part of the assessment process. Course assignments that are evaluated/graded (e.g., exams, papers, tutorials, etc.) are often seen as formal assessment techniques.

While evaluation is an important component of most classrooms, it does have some limitations. For example, if the class average on an exam is a 45%, is seems pretty clear that something went wrong along the way. When one has only evaluated the final learning product, it can be challenging to go back and discover what happened. It can also be difficult to address the situation or provide opportunities for students to learn from their mistakes. Yes, a curve on an exam can help address a low class average, but does it help the students learn? Engaging in informal assessment activities throughout the course can help avoid this situation.

Assessment process:

1. Establishing expected learning outcomes for the course;
2. Systematically gathering, analyzing, and interpreting evidence (through formal assessment activities such as exams or papers and informal assessment activities such as in-class discussions exercises) to determine how well the students' learning matches:
    - Faculty expectations for what students will learn and
    - The stated expected learning outcomes for the course

3. Faculty members should use this evidence/assessment of student learning to:
    - Provide questioner to students about their learning (or lack thereof) and
    - Adjust their teaching methods and/or students' learning behaviors to ensure greater student learning (Maki, 2004).

The Best Practice in a Classroom Assessment and is an example of a method that can be used to assess learning outcomes. At the end of a class period or major topic, faculty ask students to anonymously write down what point(s) were the most unclear to them. After class, faculty members review these responses and then re-teach or re-address any confusing topics, thus increasing student learning

(Angelo & Cross, 1993).

7. DESCRIPTION OF A COURSE PURPOSE:

Determining the PURPOSE of teaching the course:

When planning a course and determining the Learning Outcomes for that course, it is important to examine the course's purpose within the context of the college, and/or the department/program. This process will assist faculty in determining the intent of the course as well as how the course fits into the curriculum. This will help identify the essential knowledge, skills, etc. that should be incorporated into the course and the stated expected learning outcomes for the course. The course purpose section should clarify the course's standing within the program *(e.g., is the course required or an elective?, does this class have a pre-requisite?, etc.).* It should also describe the course's role in the departmental/programmatic curriculum by addressing the intent (importance, main contribution, intrinsic value, etc.) of the class.

STEP ONE:
Determine if the course is part of the IEEE / ACM / AICTE Model Curriculum:

A **flexible alternating current transmission system** (FACTS) is a system composed of static equipment used for the AC Transmission of Electrical Energy. It is meant to enhance controllability and increase power transfer capability of the network. It is generally a Power Electronics-based system.

FACTS are defined by the EEE as power electronic based and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability.

According to Siemens "FACTS, Increase the reliability of AC grids and reduce power delivery costs. They improve transmission quality and efficiency of power transmission by supplying inductive or reactive power to the grid.

STEP TWO: Determine how the course fits into the departmental curriculum:

Here are some questions to ask to help determine how a course fits in the departmental curriculum:

What role does the course play in the departmental/programmatic curriculum?

- Is this course required?
- Is this course an elective?
- Is this course required for some students and an elective for others?
- Does this class have a pre-requisite
- Is this class a pre-requisite for another class in the department
- Is this course part of IEEE / ACM / AICTE Model Curriculum

How advanced is this course?

- Is this course an undergraduate or graduate course
- Where does this course fall in students' degree plan - as an introductory course or an advanced course?
- Can I expect the students taking this course to know anything about the course topic
- Are other faculty members counting on students who have taken this course to have mastered certain knowledge or skills

When students leave this course, what do they need to know or be able to do?

- Is there specific knowledge that the students will need to know in the future.
- Are there certain practical or professional skills that students will need to apply in the future?

- Five years from now, what do you hope students will remember from this course

What is it about this course that makes it unique or special?

- Why does the program or department offer this course
- Why can't this course be "covered" as a sub-section of another course
- What unique contributions to students' learning experience does this course make
- What is the value of taking this course? How exactly does it enrich the program or department

8. PROCEDURE FOR DEVELOPMENT OF EXPECTED LEARNING OUTCOMES FOR A COURSE

The following pages should be of assistance in developing several broad, effectively stated expected learning outcomes for a course. When beginning to construct expected learning outcome statements, it is always good to think about the learners.

Please take a moment to think about the student learners in the course. Please consider the following questions:

- What are the most essential things the students need to know or be able to do at the end of this course
- What knowledge and skills will they bring with them
- What knowledge and skills should they learn from the course

When you begin thinking about the expected learning outcomes for a course, it is a good idea to think broadly. Course-level expected learning outcomes do not need to focus on small details; rather, they address entire classes of theories, skill sets, topics, etc.

The "Course Description" contains the following contents:

- Course Overview
- Prerequisite(s)
- Marks Distribution
- Evaluation Scheme
- Course Objectives
- Course Outcomes
- How Course Outcomes are assessed
- Syllabus
- List of Text Books / References / Websites / Journals / Others
- Course Plan
- Mapping course objectives leading to the achievement of the programme outcomes
- Mapping course outcomes leading to the achievement of the programme outcomes

9. REFERENCES:

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ANNEXURE - A: SAMPLE COURSE DESCRIPTOR

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING COURSE

DESCRIPTOR

Course Title	**ELECTRICAL CIRCUITS**				
Course Code	AEEB03				
Programme	B.Tech				
Semester	II	EEE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	2	1
Chief Coordinator	**Dr. D Shobha Rani, Professor, EEE**				
Course Faculty	**Dr. D Shobha Rani, Professor, EEE** **Ms. S Swathi, Assistant Professor, EEE**				

I. COURSE OVERVIEW:

This course introduces the concepts of basic electrical engineering parameters, quantities, analysis of DC circuits. The course teaches different fundamental laws Ohms laws, Kirchhoff laws and different electrical concepts. The students will be able to analyze networks using graph theory and also emphasis of this course is laid on the basic analysis of circuits which includes three phase circuits. This subject includes Components of LT Switch gear, characteristics for batteries, applications.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
UG	AHSB02	I	Linear Algebra and Calculus

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks

Electrical Circuits	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make- up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**			**Total Marks**
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning centre. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Seminars
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	3	Term paper
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.	2	Discussion of real-time applications
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.	2	Discussion of real-time applications

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO 2	**Problem Solving Skills:** To explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally	2	Discussion of real-time applications
PSO 3	**Successful career and entrepreneurship:** To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test, maintain power systems and industrial applications.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic parameters, formation of circuit and network.
II	Apply different network reduction techniques to solve complex electrical networks and Use network topology technique to solve complex electrical networks.
III	Analyze single phase AC circuits and their behaviour and Summarize the conditions for electrical resonance
IV	Explain the importance of magnetic circuits and their behaviour in electrical engineering and Explain the components of LT switchgear and types of batteries

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEEB03.1	CLO 1	Define the various nomenclature used to study the DC electrical circuits.	PO1	3
AEEB03.2	CLO 2	Understand the concept of electrical circuit and classify electrical circuits elements	PO1	3
AEEB03.3	CLO 3	List out types of energy sources and describe source transformation technique to determine equivalent resistance and source current.	PO1, PSO2	3
AEEB03.4	CLO 4	Apply network reduction techniques to calculate unknown quantities associated with electrical circuits.	PO1, PO2	3
AEEB03.5	CLO 5	Apply Ohm's law and Kirchhoff's laws to determine equivalent resistance and current/voltage in any branch of a circuit.	PO1	3
AEEB03.6	CLO 6	Discuss the various nomenclatures related with network topology.	PO1	3
AEEB03.7	CLO 7	Formulate incidence, tie-set and cut-set matrix which are used to solve the behavior of complex electrical circuits.	PO1	3
AEEB03.8	CLO 8	Understand the concepts of duality and importance of dual networks.	PO2	3
AEEB03.9	CLO 9	Interpret the alternating quantities with its instantaneous, average and root mean square values.	PO2	3
AEEB03.10	CLO 10	Illustrate the concept of impedance, reactance, admittance, susceptance and conductance.	PO1	3
AEEB03.11	CLO 11	Analyze the steady state behavior of R, L and C elements with sinusoidal excitation.	PO1, PO2	3
AEEB03.12	CLO 12	Analyze the steady state behavior of series and parallel RL, RC and RLC circuits with sinusoidal excitation.	PO2	3
AEEB03.13	CLO 13	Analyze three phase star and delta circuits with different configuration.	PO2	3
AEEB03.14	CLO 14	Understand the concept of Phasor diagram for three phase systems and Discuss the active, reactive and apparent power and power factor in three phase circuits.	PO1, PO2, PO3	3
AEEB03.15	CLO 15	Explain the importance of magnetic circuits and their behaviour in electrical engineering.	PO1	3
AEEB03.16	CLO 16	Study the components of LT switch gear and characteristics different types of batteries.	PO3, PO6, PSO2	3
AEEB03.17	CLO 17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.	PO3, PO6	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2	3														
CLO 3	3													2	
CLO 4	3	3													
CLO 5	3														
CLO 6	3														
CLO 7	3														
CLO 8		3													
CLO 9		3													
CLO 10	3														
CLO 11	3	3													
CLO 12		3													
CLO 13		3													
CLO 14	3	3	2												
CLO 15	3														
CLO 16			2			2								2	
CLO 17			2			2									

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES - DIRECT

CIE Exams	PO1, PO2, PO6, PSO2	SEE Exams	PO1, PO2, PO6 PSO2	Assignments	-	Seminars	PO1, PO2, PO6 PS02
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO6, PSO2						

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS:

Module-I	**INTRODUCTION TO ELECTRICAL CIRCUITS**
Circuit concept: Basic definitions, Ohm's law at constant temperature, classifications of elements, R, L, C parameters, independent and dependent sources, voltage and current relationships for passive elements (for different input signals like square, ramp, saw tooth, triangular and complex), temperature dependence of resistance, tolerance, source transformation, Kirchhoff"s laws, equivalent resistance of series, parallel and series parallel networks.	
Module-II	**ANALYSIS OF ELECTRICAL CIRCUITS**
Circuit analysis: Star to delta and delta to star transformation, mesh analysis and nodal analysis by Kirchhoff"s laws, inspection method, super mesh, super node analysis; Network topology: definitions, incidence matrix, basic tie set and basic cut set matrices for planar networks, duality and dual networks.	
Module-III	**SINGLE PHASE AC CIRCUITS AND RESONANCE**
Single phase AC circuits: Representation of alternating quantities, instantaneous, peak, RMS, average, form factor and peak factor for different periodic wave forms, phase and phase difference, „j" notation, concept of reactance, impedance, susceptance and admittance, rectangular and polar form, concept of power, real, reactive and complex power, power factor. Steady state analysis: Steady state analysis of RL, RC and RLC circuits (in series, parallel and series parallel combinations) with sinusoidal excitation; Resonance: Series and parallel resonance, concept of band width and Q factor.	
Module-IV	**MAGNETIC CIRCUITS AND THREE PHASE CIRCUITS**
Magnetic circuits: Faraday's laws of electromagnetic induction, concept of self and mutual inductance, dot convention, coefficient of coupling, composite magnetic circuit, analysis of series and parallel magnetic circuits; Three phase circuits: Star and delta connections, phase sequence, relation between line and phase voltages and currents in balanced systems(both Y&Δ),three phase three wire and three phase four wire systems, analysis of balanced and unbalanced three phase circuits, measurement of active and reactive power	
Module-V	**COMPONENTS OF ELECTRICAL SYSTEMS**
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, types of wires and cables, Earthing. Types of batteries, Alkaline battery, zinc–carbon battery, dry cell battery, nickel–cadmium battery, lead–acid battery, lithium ion battery, nickel metal hydride battery, important characteristics for batteries, applications, Elementary calculations for energy consumption.	
Text Books:	
1. A Chakrabarthy, "Electric Circuits", DhanipatRai& Sons, 6th Edition, 2010. 2. A Sudhakar, Shyammohan S Palli, "Circuits and Networks", Tata McGraw-Hill, 4th Edition, 2010. 3. M E Van Valkenberg, "Network Analysis", PHI, 3rd Edition, 2014. 4. D.P. Kothari and I.J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 3rd Edition 2010.	
Reference Books:	

1. John Bird, “Electrical Circuit Theory and Technology”, Newnes, 2nd Edition, 2003.
2. C L Wadhwa, “Electrical Circuit Analysis including Passive Network Synthesis”, New Age International, 2nd Edition, 2009.
3. David A Bell, “Electric circuits”, Oxford University Press, 7th Edition, 2009.

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Discuss the basic definitions like potential, potential difference, charge, current and power	CLO 1	T2:1.1
2	Understand the Ohms’ law at constant temperature and its limitations	CLO 2	T2:1.5
3	Discuss active, passive, linear, non-linear, bilateral, lumped, distributed, unilateral and bilateral elements	CLO 2	T2:1.6
4	Describe voltage and current relations of resistance, inductance and capacitance	CLO 2	T2:1.7
5	Understand the voltage and current relationships for passive elements	CLO 2.	T2:1.7
6	Explain Independent, dependent sources and their symbols	CLO 3	T2:1.9
7	State and explain Kirchhoff’s laws	CLO4	T2:1.12
8	Apply the concept of Kirchhoff's laws in source transformation technique	CLO4	T2:3.1
9	Apply the concept of Kirchhoff's laws in circuit reduction technique	CLO5	T2:1.13
10	Analyze the problems on circuit reduction technique	CLO5	T2:1.15
11	Derive the formula for star to delta transformation technique	CLO4	T2:3.1
12	Derive the formula for delta to star transformation technique	CLO4	T2:3.1
13	Analyze the problems on star to delta transformation technique	CLO4, CLO5	T2:3.1
14	Apply the concept of Kirchhoff's voltage law in mesh analysis	CLO4, CLO5	T2:2.9
15	Apply the concept of Kirchhoff's current law in nodal analysis	CLO4, CLO5	T2:2.12
16	Can solve the electrical networks using nodal analysis to determine current, voltage and power in each element of the network.	CLO4, CLO5	T2:2.15
17	Understand numerical problems on mesh and Super mesh analysis	CLO4, CLO5	T2:2.15
18	Understand problems on mesh and Super mesh analysis	CLO4, CLO5	T2:2.11
19	Understand the fundamentals of network topology and Define graph, sub graph, path, directed graph, tree and co-tree	CLO6	T2:2.1
20	Develop an incidence Analyze numerical problems on incidence matrix using graph theory	CLO7	T2:2.3
21	Develop basic Tie set matrix for planar networks and Analyze numerical problems on basic Tie set matrix for planar networks	CLO7	T2:2.7
22	Develop basic Cut set matrix for planar networks and Analyze numerical problems on basic cut set matrix for planar networks.	CLO7	T2:2.7
23	Explain Duality and Dual networks	CLO8	T2:3.8

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
24	Identify the alternating quantities with it instantaneous, average and root mean square values.	CLO9	T2:4.1
25	Identify the alternating quantities with it instantaneous, average and root mean square values.	CLO9	T2:4.1
26-30	Demonstrate the impression of reactance, suceptance, impedance and admittance in estimating power of AC circuits.	CLO10	T2:4.2
31	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation	CLO11	T2:4.5
32	Steady state analysis: steady state analysis C circuits with sinusoidal excitation.	CLO12	T2:4.5
33	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	CLO12	T2:4.6
34	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation.	CLO12	T2:4.7
35	Analyze the steady state behavior of series and parallel RL, RC and RLC circuit with sinusoidal excitation	CLO12	T2:4.8
36	Explain the concept of resonance for series and parallel circuits	CLO12	T2 – 8.13
37	Explain the concept of resonance for series and parallel circuits.	CLO12	T2 – 8.14
38	Explain the concept of resonance for series and parallel circuits.	CLO12	T2 – 8.15
39	Understand the basic formation of magnetic circuit.	CLO15	T1:10.11
40	Analyze the faradays laws and their usage to write self and mutual inductance.	CLO15	T1:10.11
41	Able to represent the total emf induced in coil using dot convention.	CLO15	T1:10.4
42	Can decide the amount of mutual flux linkage between two coils.	CLO15	T1:10.5
43	Behavior of different types magnetic circuits can be analyze.	CLO15	T1:10.15
44	Analyze three phase star and delta circuits with different configuration. Understand the concept of Phasor diagram for three phase systems.	CLO13	T2, 9.3
45-48	Analyze three phase star and delta circuits with different configuration.	CLO13	T2, 9.6; 9.7; 9.9; 9.10
49	Discuss the active, reactive and apparent power and power factor in three phase circuits	CLO14	T2, 9.11
50	Discuss the active, reactive and apparent power and power factor in three phase circuits	CLO14	T2, 9.11
51-52	Analyze three phase star and delta circuits with different configuration. Discuss the active, reactive and apparent power and power factor in three phase circuits.	CLO14	T2, 9.13; 9.15
53	Understand concept of Switch fuse unit, MCB.	CLO16	T3, 10.11
54	Understand concept of ELCB, MCCB.	CLO16	T3, 10.11
55	Understand concept of wiring.	CLO16	T3, 10.12
56	Understand concept of cables.	CLO16	T3, 10.13
57	Understand concept of earthing.	CLO16	T3, 10.14

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
58	Understand concept of Alkaline battery, Zinc–Carbon battery. lead acid battery, lithium ion battery, nickel metal hydride battery.	CLO16	T3, 10.15
59	Understand Characteristics for batteries and Applications of different batteries	CLO16	T3, 10.18
60	Understand concept of elementary calculations for energy consumption.	CLO16	T3, 10.24

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Analysis of electrical circuits using MATLAB	Seminars and Laboratory Practice	PO2	---
2	Design of electrical circuit using graph theory in PC	Seminars and Laboratory Practice	PO3	PSO2

Prepared by:

Dr. D Shobha Rani, Professor, EEE

Ms .S. Swathi, Assistant Professor, EEE

HOD, EEE