



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

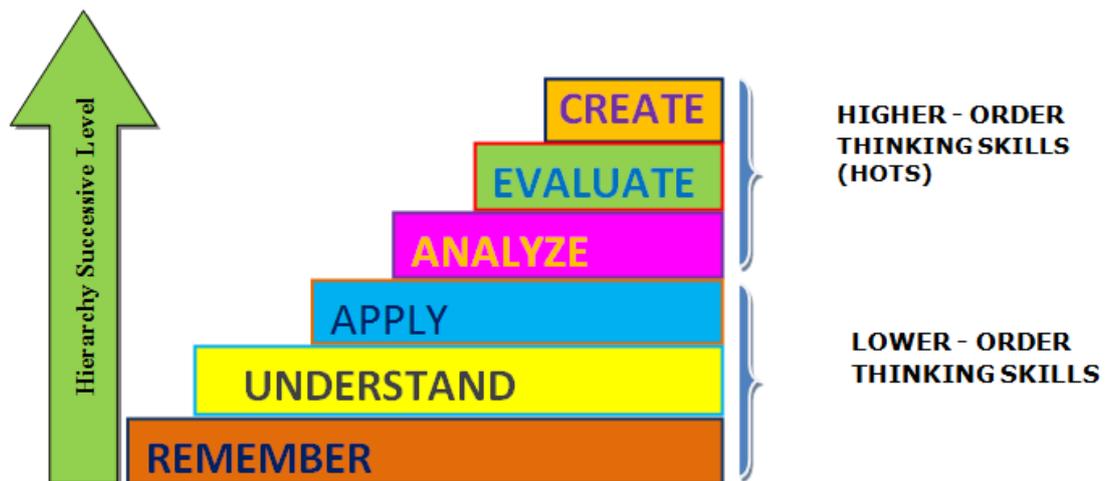
Dundigal - 500 043, Hyderabad

OUTCOME BASED EDUCATION SYSTEM

ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech

2014 – 2018 Admitted Batch



BLOOM'S TAXONOMY OF LEARNING OUTCOMES

.....Moving Towards Perfection in Engineering

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

S. No.		Page No.
PART – I(As Per NBA Norms post June, 2015)		
1	Program Educational Objective, Outcomes and assessment criteria	5
2	B. Tech Electrical and Electronics Engineering Program Educational Objectives	6
3	B. Tech Electrical and Electronics Engineering Program Outcomes Program Specific Outcomes	8
4	Mapping of Program Educational Objectives to Program Outcomes and Program Specific Outcomes	9
5	Relation between the Program Outcomes and Program Specific Outcomes and the Program Educational Objectives	13
6	Program Outcomes and Program Specific Outcomes of (B. Tech) EEE Graduates	15
7	Procedures for Outcome Delivery and Assessment with Respect to Program Outcomes and Program Specific Outcomes	21
8	Methods of Measuring Learning Outcomes and Value Addition	27
PART – II ASSESSMENT OF COURSE LEVEL STUDENT LEARNING OUTCOMES		
1	Course Purpose	31
2	Expected Learning Outcomes	31
3	To Define Effective Learning Outcome Statements	32
4	Tips for Developing Course Level Expected Learning Outcomes Statements	34
5	Sample Expected Learning Outcomes Statements	35
6	An Overview of Assessment	36
7	Description of a Course Purpose	37
8	Procedure for Development of Expected Learning Outcomes for a Course	38
9	References	39
ANNEXURES		
A	Sample Course Description (As Per NBA Norms post June, 2015)	41

As Per NBA Norms Post June, 2015
Semester: I, 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 DAC EEE on 24/1/2015):

Electrical and Electronics Engineering Departmental Advisory Council:

The Electrical and Electronics Engineering Department Advisory Council (EEEDAC) 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, Electronics & Communications 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 Advisory Board are implemented for improvements year on year. The meeting of the Advisory Board is conducted annually. Additional meetings are conducted as required, to review strategic planning and innovative programs for their impact on programs. The Advisory Council visits the institute and holds meeting with representatives of administration, faculty and the students. The secretary of departmental council presents a report to the council, on improvements and amendments to the program. The advisory council 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 the 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 (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 telecons, 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:

- i. Successfully completing the graduate course
- ii. Self-learning; a new skill, tool, area system
- iii. Reading technical books, journals, conference papers, technical reports or standards

- iv. Attending a technical conference, symposium or workshop
- v. 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 ENGINEERING 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: 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

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.

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	PO: 1,2,3,4,5,6,9,10,11	PO: 1,6,7,8,9,10,11,12	PO: 6,7,8,9,10,11,12

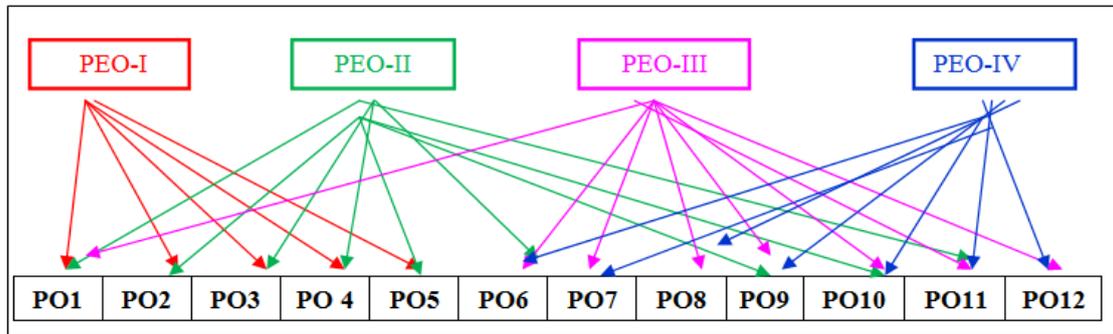


Figure: Correlation between the PEOs and the POs

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

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

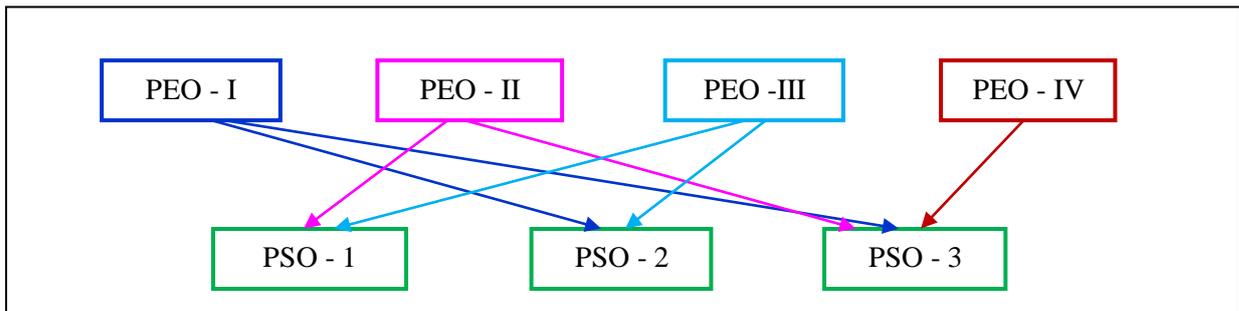


Figure: The correlation between the PEOs and the PSOs

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

	Program Educational Objectives	Program Outcomes
I	Success in Electrical Engineering area	<p>PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</p> <p>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.</p>

		<p>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.</p> <p>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.</p> <p>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.</p>
II	Industrial awareness and research	<p>PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</p> <p>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.</p> <p>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.</p>
III	Successful employment and professional ethics	<p>PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the</p>

		<p>solution of complex engineering problems.</p> <p>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.</p> <p>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.</p> <p>PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</p> <p>PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</p> <p>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.</p> <p>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.</p> <p>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.</p>
<p>IV</p>	<p>Being an leader professional and societal environment</p>	<p>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.</p> <p>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.</p> <p>PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</p> <p>PO4: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</p> <p>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.</p> <p>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.</p> <p>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.</p>

POs

	Program Educational Objectives	PSO'S
I	Success in Electrical Engineering area	<p>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.</p> <p>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.</p>
II	Industrial awareness and research	<p>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.</p> <p>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</p>
III	Successful employment and professional ethics	<p>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.</p> <p>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.</p>
IV	Being an leader professional and societal environment	<p>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</p>

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)		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	H	H	H	S
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	H	H	S	S
PO-3	Design solutions for complex engineering problems and design system components or processes that meet	H	H	S	S

	the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations				
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	H	H	S	S
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.	H	H	S	S
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.	M	H	H	H
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.	S	S	H	H
PO-8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	S	S	H	H
PO-9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	S	H	H	H
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.	S	H	H	H
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.	S	H	H	H
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	S	S	H	H
Relationship between Program Outcomes and Program Educational Objectives Key: H = Highly Related; S = Supportive					

RELATION BETWEEN THE PROGRAM SPECIFIC OUTCOMES AND THE PROGRAM EDUCATIONAL OBJECTIVES

Program Educational Objectives (PEOs)		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.	S	H	H	S

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.	H	S	H	S
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	S	S	S	H
Relationship between Program Specific Outcomes and Program Educational Objectives Key: H = Highly Related; S = Supportive					

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 OUTCOMES OF (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, processor 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 some 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: 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

Performance Criteria Definitions

- Limits on type of transmission can be understood.
- The insulation technology plays major role 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: 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.

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: 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.

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 (JNTUH-R13) –Vs- Program Outcomes and Program Specific Outcomes Attained through course modules for I, II-I II-II, III-I, III-II, IV-I, IV-II Semesters

I Year B.Tech																	
Code	Subject	PO												PSO			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
A10001	English	x	x		x											x	x
A10002	Mathematics-I		x				x		x	x	x		x	x	x	x	x
A10003	Mathematical Methods	x		x	x									x			x
A10004	Engineering Physics	x		x	x			x						x			x
A10005	Engineering Chemistry	x	x		x			x	x							x	x

A10501	Computer Programming					X				X	X	X	X	X	X		
A10301	Engineering Drawing	X		X	X											X	X
A10083	English Language Communication Skills lab	X	X		X									X			X
A10081	Engineering Physics and Engineering Chemistry Lab	X	X	X	X			X	X						X	X	
A10581	Computer Programming Lab					X				X	X	X	X	X	X	X	
A10082	IT workshop/ Engineering Workshop			X													X
II B.Tech- I Semester																	
A30007	Mathematics-III	X	X		X										X	X	
A30102	Fluid Mechanics and Hydraulic Machines			X	X			X							X		X
A30404	Electronic Devices and Circuits	X	X	X												X	X
A30204	Electrical Circuits	X	X	X	X											X	
A30403	Electromagnetic Fields	X	X	X	X										X	X	
A30206	Electrical Machines – I	X	X	X				X	X	X					X	X	
A30181	Fluid Mechanics and Hydraulic Machines Lab			X	X			X								X	
A30482	Electronic Devices and Circuits Lab	X	X	X												X	
II B. Tech-II Semester																	
A40010	Managerial Economics & Financial Analysis	X												X			X
A40214	Power Systems – I	X	X	X				X	X	X						X	X
A40413	Electronics Circuits	X	X	X												X	X
A40407	Switching Theory and Logic Design	X	X		X	X										X	
A40213	Network Theory	X	X	X												X	
A40212	Electrical Machines-II	X		X	X			X	X	X					X	X	
A40287	Electrical Machines Lab –I	X	X	X				X	X	X					X	X	
A40286	Electrical Circuits and Simulation Lab	X	X	X	X										X	X	
III B.Tech-I Semester																	
A50423	IC Applications	X	X	X													X
A50014	Management Science	X												X			X
A50221	Power Systems – II	X	X	X	X			X							X	X	
A50211	Control Systems	X	X	X	X	X		X								X	X
A50220	Power Electronics	X	X	X	X	X										X	X
A50218	Electrical Machines –	X		X	X			X	X	X					X	X	
A50289	Electrical Machines Lab- II	X		X	X			X	X	X					X	X	
A50086	Advanced Communication Skills Lab									X	X	X		X			X
III B.Tech-II Semester																	
A60223	Electrical and Electronic Instrumentation	X		X	X			X	X			X			X		
A60225	Static Drives	X	X	X	X			X							X	X	
A60222	Computer Methods in Power	X	X	X	X	X		X							X	X	
A60430	Micro Processors and Interfacing Devices	X		X		X		X		X		X					X
A60009	Environmental Studies							X	X								X
A60290	Control System and Simulation Lab	X	X	X	X	X		X								X	X
A60291	Power Electronics and Simulation	X	X	X	X	X										X	X
IV B.Tech-I Semester																	
A70231	Switch Gear Protection	X		X				X	X	X					X	X	
A70232	Utilization of Electrical Energy	X	X					X							X	X	
A70421	Digital Signal Processing	X		X						X						X	X
A70230	Power System Operation and Control	X			X			X	X						X	X	
A70293	Electrical Measurements Lab	X		X	X			X	X			X			X	X	
A70498	Micro Processor and Interfacing Devices Lab	X		X		X		X		X		X				X	X
IV B.Tech–II Semester																	
A1430	Fundamentals of HVDC and FACTS Devices	X	X	X		X	X			X		X			X	X	
ELECTIVE – I																	
A70228	High Voltage Engineering			X	X			X	X		X		X		X	X	

Code	Subject	Code	Subject
A40287	Electrical Machines Lab-I	A80234	Advanced Control Systems
III B.Tech I Semester		A1227	Optimization Techniques
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.			
I Year		A40286	Electrical circuits and simulation lab
A10001	English	III B.Tech I Semester	
A10002	Mathematics-I	A50423	IC applications
A10005	Engineering Chemistry	A50221	Power Systems-II
A10083	English Communication Skills Lab	A50211	Control Systems
II B.Tech I Semester		A50220	Power Electronics
A30007	Mathematics-III	III B.Tech II Semester	
A30404	Electronic Device And Circuits	A60225	Static Devices
A30204	Electrical Circuits	A60222	Computer Methods In Power Systems
A30403	Electro Magnetic Fields	A60290	Control Systems And Simulation Lab
A30206	Electrical Machines-I	A60291	Power Electronics And Simulation Lab
A30482	Electronic Device And Circuits Lab	IV B.Tech I Semester	
II B.Tech II Semester		A70232	Utilization of Electrical Energy
A40214	Power Systems-I	A70435	Digital Control System
A40413	Electronics Circuits	A70226	Electrical Distribution Systems
A40407	Switching Theory And Logic Design	IV B.Tech II Semester	
A40213	Network Theory	A80237	Fundamental of HVDC an FACTS
A40287	Electrical Machines-I lab	A80234	Advanced Control Systems
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.			
I Year		A50220	Power Electronics
A10003	Mathematical Methods	A50218	Electrical Machines-III
A10004	Engineering Physics	A50289	Electrical Machines-II Lab
A10301	Engineering Drawing	A50086	Advanced Communications Skills Lab
A10081	Engineering Physics And Chemistry Lab	III B.Tech II Semester	
A10082	Engineering/IT work shop	A60223	Electrical and Electronics Instrumentation
II B.Tech I Semester		A60225	Static Devices
A30102	Fluid mechanics and Hydraulic Machines	A60222	Computer Methods In Power Systems
A30404	Electronic Device And Circuits	A60430	Micro Processors And Interfacing Devices
A30204	Electrical Circuits	A60290	Control systems and simulation lab
A30403	Electro Magnetic Fields	A60291	Power electronics and simulation lab
A30206	Electrical Machines-I	IV B.Tech I Semester	
A30181	Fluid mechanics and Hydraulic Machines-I	A70231	Switchgear protection
A30482	Electronic Device and Circuits Lab	A70421	Digital signal processing
II B.Tech II Semester		A70228	High voltage engineering
A40214	Power Systems-I	A70432	VLSI design
A40413	Electronics Circuits	A70498	Microprocessors and Interfacing Lab
A40213	Network Theory	A70293	Electrical Measurements Lab
A4022	Electrical Machines-II	IV B.Tech II Semester	
A40287	Electrical Machines – I Lab	A80237	Fundamental of HVDC an FACTS
A40286	Electrical Circuits and Simulation Lab	A80324	Renewable Energy Sources
III B.Tech I Semester		A80244	Principles of Reliability Engineering
A50423	IC applications	A80234	Advanced Control Systems
A50221	Power systems-II	A80235	EHV AC Transmission
A50211	Control Systems	A82909	Nanotechnology
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.			

Code	Subject	Code	Subject
I Year		III B.Tech I Semester	
A10001	English	A50221	Power Systems-Ii
A10002	Mathematics - I	A50211	Control Systems
A10003	Mathematical Methods	A50220	Power Electronics
A10004	Engineering Physics	A50218	Electrical Machines-III
A10005	Engineering Chemistry	A50289	Electrical Machines-II Lab
A10301	Engineering Drawing	III B.Tech II Semester	
A10501	C Programming	A60223	Electrical and Electronics Instrumentation
A10081	Engineering Physics and Chemistry Lab	A60225	Static Devices
A10082	Engineering/IT Work Shop	A60222	Computer Methods in Power Systems
A10083	English Communication Skills Lab	A60290	Control Systems and Simulation Lab
II B.Tech I Semester		A60291	Power Electronics and Simulation Lab
A30007	Mathematics-III	IV B.Tech I Semester	
A30102	Fluid mechanics and hydraulic machines	A70230	Power system operation and control
A30204	Electrical circuits	A70228	High voltage engineering
A30403	Electro-magnetic fields	A70435	Digital control system
A30181	Fluid mechanics and hydraulic machines-I	A70293	Electrical measurements lab
II B.Tech II Semester		IV B.Tech II Semester	
A40407	Switching theory and logic design	A80324	Renewable energy sources
A4022	Electrical machines-II	A80234	Advanced control systems
A40286	Electrical circuits and simulation lab		
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.			
I Year		A60291	Power electronics and simulation lab
A10501	C programming	IV B.Tech I Semester	
II B.Tech II Semester		A70228	High Voltage Engineering
A40407	Switching theory and logic design	A70498	Microprocessors and Interfacing lab
III B.Tech I Semester		IV B.Tech II Semester	
A50211	Control systems	A80237	Fundamental of HVDC an FACTS
A50220	Power electronics	A80238	Neural networks & fuzzy logic
III B.Tech II Semester		A80234	Advanced Control Systems
A60222	Computer methods in power systems	A80235	EHV AC transmission
A60430	Micro-processors and interfacing devices	A82909	Nanotechnology
A60290	Control systems and simulation lab		
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			
I Year		A50289	Electrical machines-II lab
A10002	Mathematics-I	IV B.Tech I Semester	
II B.Tech I Semester		A70231	Switchgear Protection
A30206	Electrical machines-I	A70230	Power System Operation And Control
II B.Tech II Semester		A70228	High Voltage Engineering
A40286	Electrical machines-II	A70226	Electrical distribution systems
A40287	Electrical machines-I lab	IV B.Tech II Semester	
III B.Tech I Semester		A80237	Fundamental of HVDC an facts
A50218	Electrical machines-III	A82909	Nanotechnology
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.			
I Year		A60222	Computer methods in power systems
A10004	Engineering physics	A60430	Micro-processors and interfacing devices
A10005	Engineering chemistry	A60009	Environmental studies
A10081	Engineering physics and chemistry lab	A60117	Disaster management
II B.Tech I Semester		A60290	Control systems and simulation lab
A30102	Fluid mechanics and hydraulic machines	A60291	Power electronics and simulation lab

Code	Subject	Code	Subject
A30206	Electrical machines-I	IV B.Tech I Semester	
A30181	Fluid Mechanics and Hydraulic Machines-I	A70231	Switchgear protection
II B.Tech II Semester		A70232	Utilization of electrical energy
A40214	Power systems-I	A70421	Digital signal processing
A4022	Electrical machines-II	A70230	Power system operation and control
A40287	Electrical machines-I lab	A70228	High voltage engineering
III B.Tech I Semester		A70229	Optimization techniques
A50221	Power systems-II	A70227	Electrical estimation and costing
A50211	Control systems	A70498	Micro-processors and interfacing lab
A50218	Electrical machines-III	A70293	Electrical measurements lab
A50289	Electrical machines-II lab	IV B.Tech II Semester	
III B.Tech II Semester		A80324	Renewable energy sources
A60223	Electrical and electronics instrumentation	A80244	Principles of reliability engineering
A60225	Static devices	A80234	Advanced control systems
PO - 8:			
Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.			
I Year		A60223	Electrical and electronics instrumentation
A10002	Mathematics-I	A60009	Environmental studies
A10005	Engineering chemistry	A60117	Disaster management
A10081	Engineering physics and chemistry lab	A60017	Intellectual property rights
II B.Tech I Semester		A60018	Human values and professional ethics
A30206	Electrical Machines I	IV B.Tech I Semester	
II B.Tech II Semester		A70231	Switchgear protection
A40214	Power Systems-I	A70228	High voltage engineering
A4022	Electrical Machines-II	A70432	VLSI design
A40287	Electrical Machines-I lab	A70227	Electrical estimation and costing
III B.Tech I Semester		A70293	Electrical measurements lab
A50218	Electrical machines-III	IV B.Tech II Semester	
A50289	Electrical machines-II lab	A80324	Renewable energy sources
A50086	Advanced communications skills lab	A80244	Principles of reliability engineering
III B.Tech II Semester		A82909	Nanotechnology
PO - 9:			
Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.			
I Year		A60017	Intellectual Property Rights
A10002	Mathematics-I	IV B.Tech I Semester	
A10501	C programming	A70421	Digital signal processing
III B.Tech I Semester		A70228	High voltage engineering
A50086	Advanced Communications Skills lab	A70435	Digital control system
III B.Tech II Semester		A70498	Micro-processors and interfacing lab
A60430	Micro-processors and Interfacing devices	IV B.Tech II Semester	
A60009	Environmental studies	A80237	Fundamental of HVDC an FACTS
A60117	Disaster Management		
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			
I Year		A50086	Advanced communications skills lab
A10002	Mathematics-I	III B.Tech I Semester	
A10501	C programming	A60017	Intellectual property rights
III B.Tech I Semester		A60018	Human values and professional ethics
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.			
I Year		A70498	Microprocessors And Interfacing Lab
A10501	C programming	A70293	Electrical Measurements Lab

Code	Subject	Code	Subject
III B.Tech II Semester		IV B.Tech II Semester	
A60223	Electrical and Electronics Instrumentation	A80237	Fundamental of HVDC an FACTS
A60430	Microprocessors And Interfacing Devices	A80238	Neural Networks & Fuzzy Logic
A60117	Disaster Management	A80324	Renewable Energy Sources
IV B.Tech I Semester		A80244	Principles of Reliability Engineering
A70228	High Voltage Engineering	A80235	EHV AC Transmission
A70432	VLSI Design	A82909	Nanotechnology
A70227	Electrical Estimation And Costing		
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.			
I Year		A50086	Advanced communications skills lab
A10002	Mathematics-I	III B.Tech II Semester	
A10501	C programming	A60117	Disaster management
II B.Tech I Semester		A60017	Intellectual property rights
A40010	Managerial economics & financial analysis	A60018	Human values and professional ethics
III B.Tech I Semester		IV B.Tech I Semester	
A50014	Management science	A70227	Electrical estimation and costing

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

Code	Subject	Code	Subject
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			
I Year		III B.Tech I Semester	
A10002	Mathematics-I	A50221	Power Systems - II
A10003	Mathematical Methods	A50218	Electrical Machines-III
A10004	Engineering Physics	A50289	Electrical Machines lab - II
A10501	Computer Programming	III B.Tech II Semester	
A10083	English Language Communication Skills lab	A60223	Electrical and Electronic Instrumentation
A10081	Engineering Physics and Engineering Chemistry Lab	A60225	Static Drives
A10581	Computer Programming Lab	A60222	Computer Methods In Power Systems
II B.Tech I Semester		IV B.Tech I Semester	
A30007	Mathematics - III	A70231	Switch Gear Protection
A30102	Fluid Mechanics And Hydraulic Machines	A70232	Utilization of Electrical Energy
A30403	Electro-Magnetic Fields	A70230	Power System Operation And Control
A30206	Electrical Machines-I	A70293	Electrical Measurements lab
II B.Tech II Semester			
A40212	Electrical Machines - II		
A40287	Electrical Machines lab - I		
A40286	Electrical Circuits And Simulation lab		
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		A40287	Electrical Machines lab - I
A10001	English	A40286	Electrical Circuits And Simulation lab
A10002	Mathematics-I	III B.Tech I Semester	
A10005	Engineering Chemistry	A50221	Power Systems - II
A10501	Computer Programming	A50211	Control Systems
A10301	Engineering Drawing	A50220	Power Electronics
A10081	Engineering Physics and Engineering Chemistry Lab	A50218	Electrical Machines-III

A10581	Computer Programming Lab	A50289	Electrical Machines lab - II
II B.Tech I Semester		III B.Tech II Semester	
A30007	Mathematics - III	A60225	Static Drives
A30404	Electronic Devices And Circuits'	A60222	Computer Methods In Power Systems
A30204	Electrical Circuits	A60290	Control System And Simulation lab
A30403	Electro-Magnetic Fields	A60291	Power Electronics And Simulation lab
A30206	Electrical Machines-I	IV B.Tech I Semester	
A30181	Fluid mechanics And Hydraulic Machines lab	A70231	Switch Gear Protection
A30482	Electronic Devices And Circuits lab	A70232	Utilization of Electrical Energy
II B.Tech II Semester		A70421	Digital Signal Processing
A40214	Power Systems - I	A70230	Power System Operation And Control
A40413	Electronics Circuits	A70293	Electrical Measurements lab
A40407	Switching Theory And Logic Design	A70498	Microprocessor And Interfacing Devices lab
A40213	Network Theory		
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		A50211	Control Systems
A10001	English	A50220	Power Electronics
A10002	Mathematics-I	A50086	Advanced Communication Skills lab
A10003	Mathematical Methods	III B.Tech II Semester	
A10004	Engineering Physics	A60430	Microprocessor And Interfacing Devices
A10005	Engineering Chemistry	A60009	Environmental Studies
A10301	Engineering Drawing	A60290	Control System And Simulation lab
A10083	English Language Communication Skills lab	A60291	Power Electronics And Simulation lab
A10082	IT workshop/ Engineering Workshop	A60018	Human Values And Professional Ethics
II B.Tech I Semester		IV B.Tech I Semester	
A30102	Fluid Mechanics And Hydraulic Machines	A70421	Digital Signal Processing
A30404	Electronic Devices And Circuits'	A70498	Microprocessor And Interfacing Devices lab
II B.Tech II Semester		A70226	Electrical Distribution Systems
A40010	Managerial Economics & Financial Analysis	A70432	VLSI Design
A40214	Power Systems - I	A70435	Digital Control Systems
A40413	Electronics Circuits	A1227	Optimization Techniques
III B.Tech I Semester		IV B.Tech II Semester	
A50423	IC Applications	A80234	Renewable energy sources
A50014	Management Science	A80234	Advanced control systems

8. METHODS OF MEASURING LEARNING OUTCOMES AND VALUE ADDITION

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 class room 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 acts as a felicitor 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 under taken 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 in structures 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 senior's survey form is to be filled by all the students leaving the institution. The questionnaire is designed in such away together 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 as under graduate students, and continuing involvement with Institute of Aeronautical Engineering. This survey is administered every three years. The data obtained will be analyzed and use discontinuous 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 is also to identify gaps in technical and vocational skills, need for required training practices to fill the segaps 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 requirements of 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 solution store search/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 programming Electrical and Electronics 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 inter disciplinary studies; sufficient training and development of skills for effective communication and team work; aproper understanding of an engineer's professional and ethic a 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 meet semi-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 proceedings 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 that 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 (Susie, 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). These words 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
Recite	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 Kirchoff'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 polyphasor 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 well they* 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 final exam). 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%, it 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 IEEE 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

1. American Association of Law Libraries (2005). Writing learning outcomes. Retrieved May 31, 2005 from http://www.aallnet.org/prodev/outcomes_asp.
2. Anderson, L.W., and Krathwohl, D.R. (Eds.) (2001). *Taxonomy of learning, teaching, and assessment: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.
3. Angelo, T.A. & Cross, K.P. (1993). *Classroom assessment techniques: A handbook for college teachers* (2nd Ed.). San Francisco, CA: Jossey-Bass. Ball State University, (1999).
4. Bloom's Classification of Cognitive Skills. Retrieved, June 10, 2005 from <http://web.bsu.edu/IRAA/AA/WB/chapter2.htm>.
5. Bloom, B.S., (1956) *Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain*. Longmans, Green: New York, NY.
6. Hales, L.W. & Marshall, J.C. (2004). *Developing effective assessments to improve teaching and learning*. Norwood, MA: Christopher-Gordon Publishers, Inc.
7. Huba, M.E., (2005). Formulating intended learning outcomes. Retrieved June 16, 2005 from <http://www.viterbo.edu/academic/titleiii/events/files/Jun04/Intended%20Learning%20Outcomes.ppt#256,1>, Formulating Intended Learning Outcomes.
8. Kansas State University, (2004). Assessment of student learning plan. Retrieved May 15, 2005 from <http://www.k-state.edu/assessment/Library/templatew.doc>.
9. Kansas State University, (2004). Form for identifying strategies and processes for the assessment of student learning outcome(s). Retrieved May 15, 2005 from <http://www.k-state.edu/assessment/Library/strategies.pdf>.
10. Kansas State University, (2005). How to write student learning outcomes: Action verb List – suggested verbs to use in each level of thinking skills. Retrieved May 15, 2005 from <http://www.k-state.edu/assessment/Learning/action.htm>.
11. Krumme, G (2001). Major categories in the taxonomy of educational objectives (Bloom 1956). Retrieved June 6, 2005 from <http://faculty.washington.edu/krumme/guides/bloom1Html>.
12. Maki, P.L. (2004). *Assessing for learning: Building a sustainable commitment across the institution*. Stylus: Sterling, VA.
13. Palomba, C.A. & Banta, T.W. Eds. (2001). *Assessing student competence in accredited disciplines: Pioneering approaches to assessment in higher education*. Stylus: Sterling, VA.
14. Siebold, R. & Beal, M. (May 2005). *Online course development guide: The workbook*. Presented at The Teaching Professor Conference in Shaumburg, IL.
15. Suskie, L. (ed) (2001). *Assessment to promote deep learning: Insight from AAHE's 2000 and 1999 Assessment Conferences*.
16. Suskie, L. (2004). *Assessing student learning: A common sense guide*. Anker Publishing Company: Bolton, MA.
17. St. Edward's University Center for Teaching Excellence (2004). *Task Oriented Question Construction Wheel Based on Bloom's Taxonomy*. Retrieved on May 17, 2005 from <http://www.stedwards.edu/cte/resources/bwheel.htm>.
18. Texas Tech University (2005). *Texas Tech University 2005-06 Undergraduate and Graduate Catalog Volume LXXXII*. Published by the Office of Official Publications: Lubbock.

19. TX. Texas Tech University Office of the Ombudsman, (2005). Syllabus Guide for Faculty: Tips for creating a conflict free syllabus. Retrieved June 9, 2005 from <http://www.depts.ttu.edu/ombudsman/publications/SyllabusGuideforFaculty.doc>.



INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORM

Course Title	CONTROL SYSTEMS			
Course Code	A50211			
Regulation	R13-JNTUH			
Course Structure	Lectures	Tutorials	Practicals	Credits
	4	1	00	4
Course Coordinator	Ms. S Swathi, Assistant Professor			
Team of Instructors	Prof. P Sridhar, Professor Ms. S Swathi, Assistant Professor			

I. COURSE OVERVIEW:

This course it is aimed to introduce the students the principles and applications of control systems in everyday life. The basic concepts of block diagram reduction, time analysis solutions to time invariant systems and also deals with the different aspects of stability analysis of systems in frequency domain and time domain

II. PREREQUISITES:

Level	Credits	Periods	Prerequisite
UG	4	4	Knowledge of systems, linear and non-linear control systems

III. COURSE ASSESSMENT METHODS:

a) Marks distribution:

Session marks	University end exam marks	Total marks
<ul style="list-style-type: none"> There shall be two mid term examinations. Each id term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 4 units and the second, after the completion of 4 to 8 	75	100

units each carrying 5 marks. On the total the internal marks are 25.		
<ul style="list-style-type: none"> The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of 8 questions each carrying 15 marks out of which 5 questions are to be answered their by external examination is of total 75 mark 		

IV. EVALUATION SCHEME:

S.No	Component	Duration	Marks
1	I mid examination	90 minutes	20
2	I assignment	--	05
3	II mid examination	90 minutes	20
4	II assignment	--	05
5	External examination	3 hours	75

V. COURSE OBJECTIVE:

At the end of the course, the students will be able to:

- i. Be familiar with the principles and applications of control systems in day life.
- ii. Be familiar with the linear time-invariant system and to design simple control systems.
- iii. Be familiar with Time domain approach is unified method for analyzing and designing systems modeled by either by modern or classical approach.
- iv. Be familiar with the degree or extent of the system stability. The steady state performance and transient response.
- v. Be familiar with the Computation of bode plot for given open loop transfer function, defining the stability and gain margin and phase margin for given bode plot.

VI. COURSE OUTCOMES:

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

1. **Understand** and analyze the operation of open loop and closed loop systems.
2. **Analyze** transfer functions for electro-dynamic plants and machines, with electrical, electro-mechanical, electro-pneumatic, and electro-hydraulic elements from plant site collected data.
3. **Understand** and analyze the stability of a system in S – Domain.
4. **Analyze** the control systems in the frequency domain.
5. **Understand** the problems relating to stability of control systems using various methods.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Level	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.	H	Assignments
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.	S	Exercise
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.	H	Assignments, discussion
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.	S	Exercise
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.	N	-----
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.	S	Exercise
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.	H	Discussion, seminars
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	-----
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Discussions
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.	S	Discussion, seminars
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.	S	Prototype, discussions
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	Discussions, seminars

N= None

S=Supportive

H=highly related

Text books:

1. Control systems by nagoorkani by RBA publication
2. Modern control engineering by K.Ogata,prentice hall

References:

1. Control system engineering by I.J.nagarath and M.Gopal,new age
2. Modern control theory byM.Gopal, new age

X. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning Outcomes:

Lecture no.	Learning objectives	TOIPC TO BE COVERED	Reference
1	Introduction	To understand the control system	T1:1.1
2-3	Introduction to system and control systems	To understand the Concepts of Control Systems, Open Loop and Closed loop control systems and their differences	T1:1.2
4	Differences of control system	To study the Differences of open and closed control system	T1:1.3
5	Different examples of control systems	To study the Different examples of closed control system	T1:1.4-1.7
6	classification of control systems	To understand classification of control systems	T1:1.1
7-8	feedback characteristics, Effects of feedback	To understand feed –back characteristics ,Effects of feedback	T1:1.3
9	Differential equations, Impulse Response and transfer function	To understand the Differential equations, Impulse Response and transfer function of a Control Systems.	T1:1.4
10-13	translational and rotational mechanical system	To understand and analyze the translational and rotational mechanical system	T1:1.10
14-15	Transfer Function of DC Servo motor	To understand and analyze the Transfer Function of DC Servo motor	T1:2.6
16-17	AC Servo motor	To understand the principle of AC Servo motor	T1:2.7
18	Synchro transmitter and Receiver	To understand and analyze the Synchro transmitter and Receiver transfer function.	T1:2.3
19-20	Block diagram representation of systems considering electrical systems as examples	To understand the Block diagram representation of systems considering electrical systems as examples	T1:1.11
21-23	Block diagram algebra	To understand and analyze the Problems on Block diagram algebra	T1:1.11
24-26	Representation by Signal flow graph - Reduction using Mason's gain formula.	To understand and analyze the Signal flow graph - Reduction using Mason's gain formula.	T1:1.12
27	Introduction	To understand the Time response analysis of system	T1:3.1
28	Time response of first order systems	To understand the Time response of first order systems	T1:3.5
29-30	Characteristic Equation of Feedback control systems	To understand the Characteristic Equation of Feedback control systems	T1:3.6
31-34	Transient response of second order systems - Time domain specifications	To understand and analyze Transient response of second order systems - Time domain specifications	T1:3.7
35-36	Steady state response -	To understand the Steady state response -	T1:3.10,

	Steady state errors and error constants	Steady state errors and error constants	3.11
37-39	Effects of proportional derivative, proportional integral systems.	To understand the Effects of proportional derivative, proportional integral systems.	T1:3.8
40	Introduction	To understand The concept of stability	T1:4.1
41-44	Routh's stability criterion – qualitative stability and conditional stability	Routh's stability Routh's stability criterion	T1:5.3
45	limitations of Routh's stability	To understand the limitations of Routh's stability	T1:5.3
46	Introduction	To understand The root locus concept	T1:5.8
47-52	Construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.	To understand and analyze Root locus and problems	T1:5.8
53	Introduction	To understand the frequency response analysis	T1:4.1
54	Frequency domain specifications	To understand the Frequency domain specifications expressions	T1:4.2
55-65	Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin stability Analysis from Bode Plots.	To understand and analyze transfer function from the Bode Diagram-Phase margin and Gain margin and different problems	T1:4.3,4.4,4.5, 4.6

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes											Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	S	S	S			H			S	S	S	S		S	S
II	S	S	H	S		H	S		S		S	S		H	S
III	S	S	H	S			S		S		S	S		H	S
IV	S	H	H	S		S			S	S	S	S		S	S
V	H	H	S	S		H	S		S	S	S	S		H	S

S – Supportive

H - Highly Related

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

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	S	S	S			H			S	S	S	S		S	S
2	S	S	H			H	S		S			S		S	S
3	S	H	H									S		H	S
4	S	H	H	S		S			S	S	S	S		S	S
5	H	H	S	S		H	S		S	S	S	S		H	S

S – Supportive

H - Highly Related

Prepared by: Mr. A Sathish Kumar, Assistant Professor

HOD, Electrical and Electronics Engineering