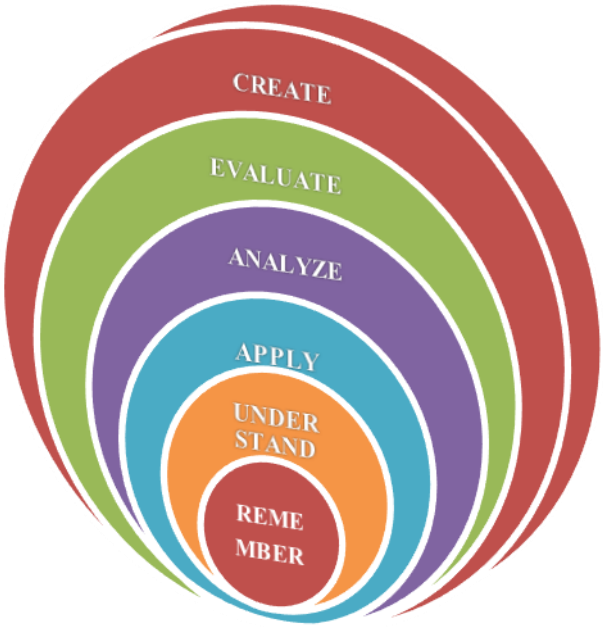
OUTCOME BASED EDUCATION BOOKLET

B. Tech
ELECTRONICS & COMMUNICATION ENGINEERING



.....Moving Towards Perfection in Engineering

SIDDHARTHA INSTITUTE OF TECHNOLOGY & SCIENCES
(UGC – AUTONOMOUS)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by *NBA, NAAC with 'A+' Grade, *nirf Ranked and ISO Certified Institution
Narapally, Korremula Road, Ghatkesar, Medchal-Malkajgiri (Dist), Telangana - 500 088

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Department of Electronics and Communication Engineering

Vision of the Department

To be a centre of excellence in electronics and communication education and research to serve industry and society needs.

Mission of the Department

MISSION	Statement
DM1	Provide state-of-art academic facilities, practice quality teaching learning process with qualified faculty.
DM2	Impart skill based training and multi-disciplinary research activities with collaborations.
DM3	Organize activities to enable overall development of stakeholders and serve the community.

CONTENTS

Part – I

Genesis and Growth

The Department of ECE Engineering was established in the year 2009 with a student intake of 60. The intake has been increased to 120 in 2010 and 180 in 2012. Besides, an additional 10% seats are under lateral entry scheme.

The department also started offering a two year M. Tech program in Embedded Systems specialization with an intake of 24 from the year 2012.

The department since its formation is committed to development in teaching and research. It strived to offer exposure to students to various challenges in VLSI, Embedded Systems, Wireless Communication, Micro Electronics, IOT, Robotics, Signal Processing and Analog and Digital System Design. It also handles consultancy works and projects.

It consists of well qualified, experienced and dedicated faculty and committed supporting staff. The department is headed by Prof. Srinivas Bachu, with a total experience of 14 years. Currently, he is ably supported by four eminent professors, Fifteen Associate Professors, and Twenty-six Assistant Professors.

Program Educational Objectives, Outcomes and Assessment Criteria: The "Program Educational Objectives" were initially drafted by a Department Advisory committee by taking consideration of stake holders (alumni, employers, students, parents) and were vetted and approved by a Governing body of the Institute

Goals

- To impart value-based education and motivate students to focus their efforts in the right direction.
- Design and equip the laboratories in the department to the emerging needs of the technology.
- Achieve 100% pass percentage in external examinations.
- Near 100% placement of all eligible students of the department.
- Establishing MoUs with reputed industries and universities for research, knowledge sharing and student placements.

Electronics and Communication Engineering Department Advisory Committee: The ECE Department Advisory Committee (ECDAC) includes a diverse group of experts from academe and industry, as well as alumni representation. The Advisory Committee meets annually, or as needed, for a comprehensive review of the ECE Department strategic planning and programs. The Advisory Committee meets with the administration, faculty and students and prepares a report, which is presented to the Principal. In each visit, the Department of ECE responds to the ECDAC report indicating improvements and amendments to the program.

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 it is 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 a period of learning. It is advisable to express learning outcomes with the 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. There is a balance to be struck between the degree of specificity in a learning outcome statement and that achieved by the assessment criteria (below).

If there are too many learning outcomes for a module, then either they are becoming assessment criteria or they are specifying too much curricular detail. The curriculum should be described in the range statement. Too few learning outcomes are unlikely to provide sufficient information on the course. As a guide, there should be between 5 and 6 learning outcomes for a course.

2. B. Tech – ELECTRONICS AND COMMUNICATION ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES

The current set of Program Educational Objectives (PEO's) for Electronics and Communication Engineering Program at MLRITM was developed by integrating the ideas of the ECE Department Faculty, students and the Departmental Advisory Council. The Advisory Council provides representation from alumni, local employers and the professional ECE Engineering community.

The Program Educational Objectives so developed reflect the professional needs of Electronics and Communication Engineering Program graduate.

The PEO's developed for its undergraduate program reflect commitment of the department to providing a program that produces graduates who, within four years of graduation, will:

PEO 1	Graduates will be able to solve Electronics and Communication Engineering problems and exhibit proficiency in computational tools.
PEO 2	Graduates will be able to communicate effectively and work in multidisciplinary teams practice the professional ethics with a sense of social responsibility.
PEO 3	Graduates will be able to have lifelong learning attitude and improve the professional knowledge.
PEO 4	Graduates will be able to pursue career in industry or research, shine as exerts and entrepreneur.

These objectives are quite broad by intention, as ECE graduates may seek further education or work in diverse areas. To make these objectives meaningful, they may be demonstrated by performance, actions, or achievements.

1. Students will establish themselves as effective professionals by solving real problems through the use of Electronics and Communication Engineering knowledge and with attention to team work, effective communication, critical thinking and problem solving skills may be demonstrated by any of the following:

    - Acceptance by and satisfactory progress in a graduate degree program;
    - Significantly contributing to delivery of desired component, product, or process;
    - Formulating and solving moderately complex engineering problems;
    - Skillfully using state-of-the-art tools for Communication engineering processes;
    - Producing clear written Electronics and Communication Engineering documentation (papers, reports, and significant parts of proposals);
    - Communicating effectively in a group environment;
    - Being asked to make presentations or reports for internal colleagues or clients;
    - Publishing refereed paper in conference or journal, or producing an internally reviewed publication;
    - Making a significant contribution to a proposal;
    - Applying for a patent or making a useful invention;
    - Participating in the field through public speaking, activity in professional societies, technical associations, standards boards, etc.

2. Students will develop skills that prepare them for immediate employment and for life-long learning in advanced areas of Electronics and Communication Engineering and related fields may be demonstrated by any of the following:

    - Successfully completing a course for B. Tech;
    - Successfully completing a tutorial at a conference;
    - Learning a new skill, Electronics and Communication Engineering application software's;
    - Reading technical books, journals, conference papers, technical reports, or standards;
    - Attending a technical conference, symposium, or workshop;
    - Belonging to a professional society;

3. Students will demonstrate their ability to adapt to a rapidly changing environment by having learned and applied new skills and new technologies may be demonstrated by any of the following:

    - Appropriately using tools for collaborating with VLSI and Embedded systems consultancy companies;
    - Skillfully using tools such as Cadence, MATLAB, Mentor Graphics, Multisim, Xilinx, Kiel ..etc for project and Research.
    - Seeking assistance or elevating problems when necessary;
    - Properly handling a situation involving intellectual property rights;

4. Students will be provided with an educational foundation that prepares them for excellence, leadership roles along diverse career paths with encouragement to professional ethics and active participation needed for a successful career by the following any one:

    - Leading a project or design team;
    - Working successfully on ethnically, technically, or gender diverse teams;

- Effectively resolving problems encountered in team work;
- Estimating correctly the required resources (time, team, equipment, etc.) for Electronics and Communication Engineering projects;
- Promotion to managerial position;
- Election or appointment to leadership position in a professional society;
- Delegating effectively;
- Participating in one of your organization's NSS programs;
- Volunteering in a college, civic, or other charitable organization;
- Participating in team sports or coaching;
- Accounting for larger societal, legal, business, and technical context while making decisions on a project;
- Properly handling a situation involving ethics;

3. B. Tech – ELECTRONICS AND COMMUNICATION ENGINEERING PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUUTCOMES

PSO1 – **ANALYZE AND DESIGN** Graduates will have an ability to analyze and design analog & digital circuits or systems for a given specification and function.

PSO2 – **IMPLEMENT:** Graduates will have an ability to Implement functional blocks of hardware-software co-designs for signal processing and communication applications.

These **PEO's** and **PSO's** represent a formal manifestation of an educational philosophy and spirit that the Civil Engineering Department has operated under for many years.

4. MAPPING OF PROGRAM EDUCATIONAL OBJECTIVES TO PROGRAM OUTCOMES

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

5. RELATION BETWEEN THE PROGRAM OUTCOMES AND PROGRAM EDUCATIONAL OBJECTIVES.

The following Table 3 shows the correlation between the PEOs and the Program Outcomes

Table 3: Relationships between Program Educational Objectives and Program Outcomes

	PEO1	PEO2

PO1	**3**	**3**
PO2	**3**	**3**
PO3	**3**	**3**
PO4	**3**	**3**
PO5	**2**	**3**
PO6	**2**	**2**
PO7	**2**	**2**
PO8	**1**	**1**
PO9	**2**	**3**
PO10	**2**	**3**
PO11	**1**	**3**
PO12	**3**	**3**
PSO1	**3**	**3**
PSO2	**3**	**3**
PSO3	**3**	**3**

Note: PEO_1, PEO_2 are distinct elements. Enter correlation levels 1,2 or 3 as defined below:
1: Low 2: Moderate (Medium) 3: Substantial (High)

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 programme coordinator.

Courses offered in Electronics and Communication Engineering Curriculum (JNTUH) –Vs- Program Outcomes and Program Specific Outcomes Attained through course modules for II-I, II-II, III-I, III-II, IV-I, IV-II Semesters

S. NO	SUBJECT Name	Code	Programme Outcomes												PSO	
			1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	MATHEMATICS-I	EC111	3.0	3.0	2.6	2.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.0	1.4
2	ENGINEERING CHEMISTRY	EC111	3.0	1.4	0.0	0.0	0.5	1.4	0.0	0.9	0.0	0.5	0.7	0.8	0.7	0.6
3	Engineering Physics-I	EC111	0.6	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.2
4	PROFESSIONAL COMMUNICATION IN ENGLISH	EC114	0.0	1.8	0.0	0.0	0.0	1.8	2.3	0.6	3.0	0.6	0.9	3.0	0.0	0.6
5	ENGINEERING MECHANICS	EC115	3.0	3.0	0.9	0.7	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.3
6	BASIC ELECTRICAL AND ELECTONICS ENGINEERING	EC116	3.0	3.0	1.3	3.0	1.3	0.0	0.0	0.0	0.0	0.5	0.0	0.5	3.0	3.0
7	ENGLISH LANGUAGE COMMUNICATION	EC117	0.0	0.0	0.0	0.0	0.0	1.5	3.0	1.5	0.0	3.0	1.5	3.0	0.5	0.5

	SKILLS LAB															
8	ENGINEERING WORKSHOP	EC118	1.8	2.6	1.8	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.2
I-II																
1	ENGINEERING PHYSICS -II	EC121	0.5	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.9
2	MATHEMATICS-II	EC122	3.0	2.8	1.3	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.3	0.0
3	MATHEMATICS-III	EC123	3.0	2.2	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0
4	COMPUTER PROGRAMMING IN C	EC124	1.5	1.0	2.2	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9
5	ENGINEERING GRAPHICS	EC125	1.5	2.3	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.0
6	ENGINEERING CHEMISTRY LAB	EC126	2.4	3.0	2.1	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	1.4
7	ENGINEERING PHYSICS LAB	EC127	2.5	3.0	2.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.8
8	COMPUTER PROGRAMMING IN C LAB	EC128	1.3	3.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.9
II-I																
1	MATHEMATICS-IV	EC211	2.2	1.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.0
2	ANALOG ELECTRONICS	EC212	3.0	3.0	3.0	3.0	1.1	0.0	0.0	0.0	0.0	0.5	0.0	0.5	3.0	3.0
3	ELECTRICAL TECHNOLOGY	EC213	1.9	3.0	2.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.0
4	SIGNALS AND STOCHASTIC PROCESS	EC214	2.6	1.6	2.3	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	3.0
5	NETWORK ANALYSIS	EC215	3.0	1.5	1.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.0
6	ELECTRONIC DEVICES AND CIRCUITS LAB	EC216	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0
7	BASIC SIMULATION LAB	EC217	3.0	3.0	2.4	2.9	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.4
8	BASIC ELECTRICAL ENGINEERING LAB	EC218	3.0	2.5	1.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.0
9	ENVIRONMENTAL SCIENCE AND TECHNOLOGY	EC219	3.0	2.1	0.9	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	3.0
II-II																
1	MATHEMATICS-IV	EC211	2.2	1.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.0
2	ANALOG ELECTRONICS	EC212	3.0	3.0	3.0	3.0	1.1	0.0	0.0	0.0	0.0	0.5	0.0	0.5	3.0	3.0
3	ELECTRICAL TECHNOLOGY	EC213	1.9	3.0	2.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.0
4	SIGNALS AND STOCHASTIC PROCESS	EC214	2.6	1.6	2.3	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	3.0
5	NETWORK ANALYSIS	EC215	3.0	1.5	1.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.0
6	ELECTRONIC DEVICES AND CIRCUITS LAB	EC216	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0

7	BASIC SIMULATION LAB	EC217	3.0	3.0	2.4	2.9	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.4
8	BASIC ELECTRICAL ENGINEERING LAB	EC218	3.0	2.5	1.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.0
9	ENVIRONMENTAL SCIENCE AND TECHNOLOGY	EC219	3.0	2.1	0.9	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	3.0
III-I																
1	ELECTROMAGNETIC THEORY AND TRANSMISSION LINES	EC311	3.0	3.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0
2	LINEAR AND DIGITAL IC APPLICATIONS	EC312	3.0	0.8	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0
3	DIGITAL COMMUNICATIONS	EC313	3.0	3.0	3.0	2.7	3.0	0.0	0.0	0.0	0.0	0.5	0.0	2.7	2.7	0.9
4	FUNDAMENTALS OF MANAGEMENT	EC314	0.5	0.5	0.8	0.9	3.0	0.5	0.8	2.5	2.0	3.0	2.2	3.0	2.2	3.0
5	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	EC315	0.9	1.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.0
6	LINEAR IC APPLICATIONS LAB	EC316	2.9	1.4	2.9	3.0	0.0	0.0	0.0	0.0	3.0	0.5	0.0	0.0	1.4	0.7
7	DIGITAL IC APPLICATIONS LAB	EC317	3.0	1.0	2.4	3.0	0.0	0.0	0.0	0.0	3.0	2.4	0.0	0.0	1.0	0.7
8	DIGITAL COMMUNICATIONS LAB	EC318	3.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	3.0	0.0	1.6	2.2	1.1
9	PROFESSIONAL ETHICS	EC319	3.0	1.2	1.1	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	3.0
III-II																
1	JAVA PROGRAMMING	EC321	1.7	1.7	1.7	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.7
2	DIGITAL IMAGE PROCESSING	EC322	2.4	1.9	2.1	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.0
3	ANTENNAS AND WAVE PROPAGATION	EC323	3.0	2.0	1.6	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	3.0
4	MICROPROCESSORS AND MICRO CONTROLLERS	EC324	3.0	3.0	2.5	2.8	3.0	0.0	0.0	0.0	3.0	0.0	0.0	2.3	3.0	2.8
5	DIGITAL SIGNAL PROCESSING	EC325	3.0	2.6	1.8	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	3.0
6	DIGITAL SIGNAL PROCESSING LAB	EC326	3.0	3.0	1.0	3.0	3.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	1.9	1.4
7	MICROPROCESSORS AND MICRO CONTROLLERS LAB	EC327	1.5	3.0	3.0	3.0	3.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	3.0	3.0
8	ADVANCED ENGLISH COMMUNICATION SKILLS LAB	EC328	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0
IV-I																
1	MICROWAVE ENGINEERING	EC411	3.0	1.4	1.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	3.0

2	COMPUTER NETWORKS	EC412	3.0	3.0	2.5	0.5	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	3.0
3	Embedded Sytem Design	EC413	3.0	3.0	2.1	0.5	3.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0
4	Artificial Intelligence	EC414	1.9	3.0	1.0	0.5	3.0	0.5	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0
5	VLSI DESIGN	EC415	3.0	1.8	1.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0
6	VLSI and ECAD LAB	EC416	3.0	1.6	1.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	3.0
7	MICROWAVE ENGINEERING LAB	EC417	3.0	1.9	1.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.0
8	INDUSTRY ORIENTED MINI PROJECT	EC418	3.0	2.4	0.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.0
9	SEMINAR	EC419	3.0	2.5	1.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.0
IV-II																
1	SENSORS AND TRANSDUCERS	EC421	3.0	3.0	3.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0	0.0	3.0	3.0	3.0
2	Optical Communications	EC422	1.3	3.0	3.0	0.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.3	0.0
3	GLOBAL POSITIONAING SYSTEM	EC423	3.0	1.8	3.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.8	2.1
4	MAJOR PROJECT	EC424	3.0	3.0	2.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.0

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

The categorization of the program outcomes and program specific outcomes of the above Electronics and Communication Engineering courses is grouped as follows:

S.No.	PO/PSO	No. of Subjects Mapped
1	PO1	60
2	PO2	61
3	PO3	55
4	PO4	52
5	PO5	23
6	PO6	14
7	PO7	9
8	PO8	11
9	PO9	14
10	PO10	17
11	PO11	8
12	PO12	17
13	PSO1	61
14	PSO2	61

7. METHODS OF MEASURING LEARNING OUTCOMES AND VALUE ADDITION

Methodologies that are used to measure student learning each have their own limitations and biases, and no method can be counted on to be completely error free. That is why best practice in educational research dictates triangulating the data. If several different sources of data are used, it increases the probability that the findings present an accurate picture. We employ the following formal assessment procedures:

1) End-of-semester course evaluations
2) Departmental mid-semester course evaluations
3) Departmental course end surveys
4) Exit surveys
5) Alumni feedback
6) Employer surveys
7) Department academic Committee meetings
8) Faculty meetings
9) Project work
10) Job Placements& Higher Education

Each is described in more detail below:

1) ***University end-of-semester course evaluations:*** J N T University conducts end-of-semester examination for all courses. Summary results for each course are distributed to the appropriate instructor and the HOD, summarizing the course-specific results and comparing them to the average across the university. Students are encouraged to write specific comments about the positive and negative aspects of the course. The statistical summary and student comments presented are submitted to the principal and department academic council for review.

2) ***Departmental mid-semester course evaluations:*** The Electronics and Communication Engineering department conducts mid-semester reviews for all courses. All departmental students are encouraged to fill out a brief survey on the state of the courses they are currently taking, and space is provided for a written comment. Faculty are strongly encouraged to review these evaluations, and draft a brief response on how they will react to correct any deficiencies noted by the students. The results are reviewed by the departmental faculty (all faculty have permission to read results for all courses).

3) ***Departmental course End surveys:*** The Electronics and Communication Engineering department conducts end-of-semester course End surveys for all of our courses. All departmental students are encouraged to fill out a brief survey on the state of the courses they are currently taking, and space is provided for a written comment. Faculty are strongly encouraged to review these evaluations, and draft a brief response on how they will react to correct any deficiencies noted by the students. The results are reviewed by the departmental faculty (all faculty have permission to read results for all courses). The results of how courses satisfy their objectives are discussed at a faculty meeting.

4) ***Exit Survey:*** Inputs from final year students are solicited annually through Electronics and Communication Engineering Exit Survey. The results are disseminated to the faculty and department advisory council for analysis and discussion. The questionnaire is designed to survey program outcomes, solicit about program experiences, career choices as

well as suggestions and comments. This instrument seeks to assess how students view the department's program in retrospect.

5) ***Alumni feedback:*** The alumni survey is a written questionnaire which alumni are asked to complete. We use this survey seeking input on the Program Objectives and Learning Outcomes based on their experience after graduation and after they have spent time in the working world. Alumni are an excellent resource with perspective on the value and advantages of their education. They are also resource for current students for potential networking and employment. The data will be analyzed and used in continuous improvement.

6) ***Employer surveys:*** The employer survey is a written questionnaire which employers of the program's graduates are asked to complete. We review the effectiveness of our curriculum and how well the student is prepared in the department of Electronics and Communication Engineering. To do this, we survey Employers and Advisors of alumni who graduated four years ago. We ask about several categories of preparation, and for each category, how well does they think he or she was prepared, and how important you think preparation in that area is to him or her in the current position. This survey will greatly assist us in determining the college overall level of achievement of our Program Educational Objectives.

7) ***Department academic committee meetings:*** The Electronics and Communication Engineering Department Advisory Council (ECDAC) includes a diverse group of experts from academe and industry, as well as alumni representation. The Advisory Board meets annually, or as needed, for a comprehensive review of the Civil Engineering department strategic planning and programs. The Advisory Council meets with administration, faculty and students and prepares a report, which is presented to principal. In each visit, the Department of Electronics and Communication Engineering responds to the report indicating improvements and amendments to the program.

8) ***Faculty meetings:*** The state of undergraduate program is always on the agenda at the monthly meeting of the faculty. The faculty devotes a substantial amount of time to formal and informal discussions assessing the state of program and searching for improvements.

9) ***Project work:*** The final project reports, must demonstrate that students produced solutions to research/industry problems involving contemporary issues. There is no scale for this tool as the reports provide qualitative data.

10) ***Job Placements& Higher studies:*** Data from the Placement and Training Centre on graduates' job placement reflects how successful our graduates are in securing a job, pursuing Higher Studies in a related field.

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 course objectives or competencies are available, the process of having expected learning outcomes for class is closer.

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) a course outline.

Expected Learning Outcomes:

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 the expected 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

a) What students are learning?
b) How well they are learning it in relation to the stated expected learning outcomes for the course?

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

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

Course description:
A formal description of the material to be covered in the course.

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

Expected learning outcome:
A formal statement of what students are expected to learn in a course (synonyms for "expected learning outcome" include learning outcome, learning outcome statement, and student learning outcome).

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, 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:

a) What role does this course play within the programme?
b) How is the course unique or different from other courses?
c) Why should/do students take this course? What essential knowledge or skills should they gain from this experience?
d) What knowledge or skills from this course will students need to have mastered to perform well in future classes or jobs?
e) Why is this course important for students to take?

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

Expected Learning Outcome (definition)
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:

1. What faculty members want students to *know* at the end of the course?
2. What faculty members want students *to be able to do* at the end of the course?

Learning outcomes have three major characteristics

1. They specify an action by the students/learners that is ***observable;***
2. They specify an action by the students/learners that is ***measurable;***
3. They specify an action that is done by the ***students/learners*** (rather than the faculty members);

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

3. TO DEFINE EFFECTIVE LEARNING OUTCOME STATEMENTS

When stating 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, and comprehend*). 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 basic Structural components.
- The students will appreciate knowledge discovery from survey field reports.

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” Structural components?
- 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 to extract knowledge from the field reports.
- The students will be able to identify the characteristics of Classification techniques from the structural components design and the analysis.

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

The Figure below shows 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 examples	Graph	Infer	Justify	Integrate
Read	Infer	Interpolate	Outline	Measure	Modify
Recall	Paraphrase	Manipulate	Point out	Rank	Order
Recite	Predict	Modify	Relate	Rate	Organize
Recognize	Rewrite	Operate	Select	Support	Plan
Record	Summarize	Prepare	Separate	Test	Prescribe
Repeat		Produce	Subdivide		Propose
Reproduce		Show	Utilize		Rearrange
Select		Solve			Reconstruct
State		Subtract			Related
Write		Translate			Reorganize
		Use			Revise
					Rewrite
					Summarize
					Transform
					Specify

. **Figure 3:** List of Action Words (Ref: Revised Version of Bloom's Taxonomy)

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 Data Mining techniques " versus "one objective of this course is to teach the names of all Data Mining 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 outcomes statements from the selected courses.

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

- **Understand** the digital circuit with HDL, simulate, synthesis and prototype in PLDs.
- **Understand** chip level issues and need of testability
- **Design** analog & digital CMOS circuits for specified applications
- **Analyze** various FPGA architectures. CO5: Design an application using Verilog HDL
- **Understand** the concepts of modeling a digital system using Hardware Description Language.
- **Analyze** the behavior of MOS and BiCMOS with various loads
- **Analyze** the VLSI Circuits through stick diagram, layout diagram 2Micro meter CMOS
- **Analyze** the transfer characteristics of CMOS logic gate
- **Design** building block of data path subsystem
- **Design** simple logic circuit using PLA, PAL, FPGA and CPLD
- **Understand** the concepts of modeling a digital system using Hardware Description Language.

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

- **Understand** the modeling of linear-time-invariant systems using transfer function and state- space representations.
- **Understand** the concept of stability and its assessment for linear-time invariant systems.
- **Design** simple feedback controllers.
- **Analyze** the various time domain parameters.
- **Design** various transfer functions of digital control system using state variable models.
- **Explore** the various control system components and their representations.
- **Analyze** the response of the closed and open loop systems.
- **Design** the various kinds of compensator.
- **Analyze** the stability of the closed and open loop systems

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

- **Understand** the importance of sampling, sampling theorem and its effects.
- **Understand** the characteristics of linear time invariant systems.
- **Evaluate** the conditions for distortion less transmission through a system.
- **Understand** the concepts of Random Process and its Characteristics.
- **Understand** the response of linear time Invariant system for a Random Processes.
- **Analyze** various signal functions.
- **Understand** the characteristics of linear time invariant systems.
- **Analyze** the signals with different transform technique
- **Understand** the convolution operator for continuous and discrete time system.

- **Understan**d and resolve the signals in frequency domain using Fourier series and Fourier transforms.

What is 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. N. Srinivas initiates a class discussion on Signals and Systems from Chapter One and determines that most of the 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. N. Srinivas 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.

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

What is involved in the 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;
   - The stated expected learning outcomes for the course;
3. Faculty members should use this evidence/assessment of student learning to:
   - Provide questionnaire to students about their learning (or lack thereof);
   - 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).

6. DESCRIPTIONOF COURSE PURPOSE

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. The following are the elaborations for each of the considerations.

Does the course form a part of the ASCE/IEI/AICTE recommendation?
The American Society of Civil Engineers (ASCE), the Institution of Engineers, India (IEI) and the All India Council of Technical Education (AICTE) have prescribed a model curriculum for civil engineering and regularly keep updating to meet the needs of the fast developing technology and industry. These form a reference to verify whether our course being offered meets the national and international standards.

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?

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?

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: **(Annexure - A)**

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

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ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**Signals and Systems**			
Course Code	2030412			
Regulation	**MLRS**(R20)			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	-	-	3
Course Coordinator	Professor Dr. B. Srinivas, ECE Department			
Team of Instructors	Professor Dr. B. Srinivas, ECE Department			

I. COURSE OVERVIEW:

This course is an introduction to the basic concepts and theory of analog and digital signal processing. The background assumed is calculus, experience in manipulating complex numbers, and some exposure to differential equations. Prior exposure to the fundamentals of circuits for electrical engineers or fundamentals of dynamics for mechanical engineers is helpful but not essential. Both for pedagogical reasons and as a reflection of the nature of modern signal processing systems, the concepts associated with continuous-time and with discrete-time signals and systems are treated together in a closely coordinated way. Among other things, this approach emphasizes both the similarities and the differences in the two classes of systems. Developing this video course has been an extremely enjoyable and rewarding experience. I hope that you also find it enjoyable, stimulating, and rewarding.

II. PREREQUISITES:

Level	Credits	Periods / Week	Prerequisites
-	3	4	Engineering Mathematics

III. COURSE ASSESSMENT METHODS:

Session Marks	University End Exam Marks	Total Marks
Mid Semester Test There shall be two midterm examinations. Each midterm examination consists of subjective type and objective type tests. The subjective test is for 10 marks of 60 minutes duration. Subjective test of shall contain 4 questions; the student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks of 20 minutes duration. It consists of 10 Multiple choice and 10 objective type questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and	75	100

half units of syllabus and second midterm examination shall be conducted for the remaining portion. **Assignment** Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course.		

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment	-	5
3	II Mid Examination	90 minutes	20
4	II Assignment	-	5
5	External Examination	3 hours	75

V. COURSE OUTCOMES:

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

CO.1	Differentiate various signal functions.
CO.2	Represent any arbitrary signal in time and frequency domain.
CO.3	Understand the characteristics of linear time invariant systems.
CO.4	Analyze the signals with different transform technique
CO.5	understand the convolution operator for continuous and discrete time system.
CO.6	Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Key Components For Assessing Program Outcomes:

PO No.	NBA Statement / Vital Features	No. of Vital Features
PO 1	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems (**Engineering Knowledge)**. Knowledge, understanding and application of 1. Scientific principles and methodology 2. Mathematical principles 3. Own and / or other engineering disciplines to integrate / support study of their own engineering discipline.	**3**
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 **(Problem Analysis).** 1. Problem or opportunity identification	

	2. Problem statement and system definition 3. Problem formulation and abstraction 4. Information and data collection 5. Model translation 6. Validation 7. Experimental design 8. Solution development or experimentation / Implementation 9. Interpretation of results 10. Documentation	**10**
PO 3.	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations (**Design/Development of Solutions).** 1. Investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues; 2. Understand customer and user needs and the importance of considerations such as aesthetics; 3. Identify and manage cost drivers; 4. Use creativity to establish innovative solutions; 5. Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal; 6. Manage the design process and evaluate outcomes. 7. Knowledge and understanding of commercial and economic context of engineering processes; 8. Knowledge of management techniques which may be used to achieve engineering objectives within that context; 9. Understanding of the requirement for engineering activities to promote sustainable development; 10. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues;	**10**
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 (**Conduct Investigations of Complex Problems).** 1. Knowledge of characteristics of particular materials, equipment, processes, or products; 2. Workshop and laboratory skills; 3. Understanding of contexts in which engineering knowledge can be applied (example, operations and management, technology development, etc.); 4. Understanding use of technical literature and other information sources Awareness of nature of intellectual property and contractual issues; 5. Understanding of appropriate codes of practice and industry standards; 6. Awareness of quality issues; 7. Ability to work with technical uncertainty. 8. Understanding of engineering principles and the ability to apply them to analyse key engineering processes; 9. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modeling techniques; 10. Ability to apply quantitative methods and computer software relevant to their engineering discipline, in order to solve engineering problems; 11. Understanding of and ability to apply a systems approach to engineering problems.	**11**

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 (**Modern Tool Usage).** 1. Computer software / simulation packages / diagnostic equipment / technical library resources/ literature search tools.	**1**
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 (**The Engineer and Society).** 1. Knowledge and understanding of commercial and economic context of engineering processes; 2. Knowledge of management techniques which may be used to achieve engineering objectives within that context; 3. Understanding of the requirement for engineering activities to promote sustainable development; 4. Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues; 5. Understanding of the need for a high level of professional and ethical conduct in engineering.	**5**
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 (**Environment and Sustainability).** Impact of the professional Engineering solutions (Not technical) 1. Socio economic, 2. Political and 3. Environmental	**3**
PO 8.	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice (**Ethics).** 1. Comprises four components: ability to make informed ethical choices, knowledge of professional codes of ethics, evaluates the ethical dimensions of professional practice, and demonstrates ethical behavior. 2. Stood up for what they believed in 3. High degree of trust and integrity	**3**
PO 9.	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings (**Individual and Teamwork).** 1. Independence 2. Maturity – requiring only the achievement of goals to drive their performance 3. Self-direction (take a vaguely defined problem and systematically work to resolution) 4. Teams are used during the classroom periods, in the hands-on labs, and in the design projects. 5. Some teams change for eight-week industry oriented Mini-Project, and for the seventeen - week design project. 6. Instruction on effective teamwork and project management is provided along with an appropriate textbook for reference. 7. Teamwork is important not only for helping the students know their classmates but also in completing assignments. 8. Students also are responsible for evaluating each other's performance, which is then reflected in the final grade. 9. Subjective evidence from senior students shows that the friendships and teamwork extends into the Junior years, and for some of those students, the friendships continue into the workplace after graduation.	**12**

	10. Ability to work with all levels of people in an organization. 11. Ability to get along with others. 12. Demonstrated ability to work well with a team.	
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 (**Communication).** "Students should demonstrate the ability to communicate effectively in writing / Orally." 1. Clarity (Writing) 2. Grammar/Punctuation (Writing) 3. References (Writing) 4. Speaking Style (Oral) 5. Subject Matter (Oral)	**5**
PO11	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 (**Project Management and Finance).** 1. Scope Statement 2. Critical Success Factors 3. Deliverables 4. Work Breakdown Structure 5. Schedule 6. Budget 7. Quality 8. Human Resources Plan 9. Stakeholder List 10. Communication 11. Risk Register 12. Procurement Plan	**12**
PO12	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 (**Life - Long Learning).** 1. Project management professional certification / MBA 2. Begin work on advanced degree 3. Keeping current in CSE and advanced engineering concepts 4. Personal continuing education efforts 5. Ongoing learning – stays up with industry trends/ new technology 6. Continued personal development 7. Have learned at least 2or 3 new significant skills 8. Have taken up to 80 hours (2 weeks) training per year	**8**

SYLLABUS

Regulation: R18

Year: II-I

Sub: SIGNALS AND SYSTEMS

Course code: 2030412

UNIT – I

Signal Analysis:

Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions, Classification of signals and systems, operations on signals, Exponential and sinusoidal signals, Concepts of impulse function, Unit step function, Signum function.

UNIT - II

Fourier Series:

Representation of Fourier series, Continuous time periodic signals, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier series and exponential Fourier series, Complex Fourier spectrum.

Fourier Transforms:

Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signals, Fourier Transform of standard signals, Fourier Transform of periodic signals, Properties of Fourier Transform, Fourier Transforms involving impulse function and signum function, Introduction to Hilbert Transform.

UNIT - III

Signal Transmission through Linear Systems:

Linear system, Impulse response, Response of a linear system, Linear time invariant(LTI) system, Transfer function of a LTI system, Filter characteristics of linear system, Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and paley-wiener criterion for physical realization, Relationship between bandwidth and rise time, Convolution and correlation of signals, Concept of convolution in time domain and frequency domain, Graphical representation of convolution

UNIT – IV

Laplace Transforms:

Laplace Transforms (L.T), Inverse Laplace Transform, Concept of region of convergence (ROC) for Laplace Transforms, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis, and it's Applications.

Z–Transforms:

Concept of Z-Transform of a discrete sequence, Distinction between Laplace, Fourier and Z Transforms, Region of convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-Transform, Properties of Z-Transforms, and it's Applications.

UNIT - V

Sampling Theorem:

Graphical and analytical proof for band limited signals, Impulse sampling, Natural and flat top sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to band pass sampling.

Correlation:

Cross correlation and auto correlation of functions, Properties of correlation functions, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between autocorrelation function and energy/power spectral density function, Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.

COURSE OUTCOMES:

At the end of the course the student will develop ability to

CO	Course outcome	Blooms taxonomy level
EC215.1	Acquire the knowledge of signals and systems	**Understand**
EC215.2	Understand the behavior of signals in time and frequency domain	**Understand**
EC215.3	Analyze the characteristics of LTI systems	**Analyze**
EC215.4	Analyze the signals with different Transform techniques	**Analyze**
EC215.5	Understand the concepts of sampling theorem, auto correlation, cross correlation and power Density Spectrum.	**Understand**
EC215.1	Evaluate the constraints on ROC for various classes of signals	**Create**

	PROGRAM OUTCOMES												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
EC215.1	1,2	1,2,3,4,5,6,7,8	-	1,2,3,4,5,6,7,8	-	-	-	-	-	2,3,4	-	-	1,2	-
EC215.2	1,2	1,2,3,4,5,6,7	-	1,2,3,4,5,6,7,8,9	-	-	-	-	-	-	-	-	1,2	-
EC215.3	-	-	-	-	-	-	-	-	-	1,2,3,4,5	-	-	1,2	-
EC215.4	-	1,2,3,4,5,6,7,8	-	1,2,3,4,5,6,7,8	-	-	-	-	-	-	-	-	1,2	-
EC215.5	1,2	1,2,3,4,5,6,7,8	-	-	-	-	-	-	-	1,2,3,4	-	-	1,2	-
EC215.6	1,2	1,2,3,4,5,6,7,8	-	1,2,3,4,5,6,7	-	-	-	-	-	-	-	-	-	-

NUMBER OF KEY COMPETENCIES FOR CO – PO MAPPING:

Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**
No.Key Components	**3**	**10**	**10**	**11**	**1**	**5**	**3**	**3**	**12**	**5**	**12**	**8**	**2**	**2**
EC215.1	2	8		8						3			2	
EC215.2	2	7		9									2	
EC215.3										5			2	
EC215.4		8		8									2	
EC215.5	2	8								4			2	
EC215.6	2	8		7										

PERCENTAGE OF KEY COMPETENCIES FOR CO – PO MAPPING:

Program outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**

No.Key Components	3	10	10	11	1	5	3	3	12	5	12	8	2	2
EC215.1	67	80	0	73	0	0	0	0	0	80	0	0	100	0
EC215.2	67	70	0	82	0	0	0	0	0	80	0	0	100	0
EC215.3	0	0	0	0	0	0	0	0	0	100	0	0	100	0
EC215.4	0	80	0	73	0	0	0	0	0	0	0	0	100	0
EC215.5	67	80	0	0	0	0	0	0	0	80	0	0	100	0
EC215.6	67	80	0	64	0	0	0	0	0	0	0	0	0	0

COURSE ARTICULATION MATRIX (CO - PO / PSO MAPPING):

Program outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	PSO 3
EC215.1	3	3	0	3	0	0	0	0	0	3	0	0	3	0	3
EC215.2	3	3	0	3	0	0	0	0	0	3	0	0	3	0	3
EC215.3	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0
EC215.4	0	3	0	3	0	0	0	0	0	0	0	0	3	0	0
EC215.5	3	3	0	0	0	0	0	0	0	3	0	0	3	0	3
EC215.6	3	3	0	3	0	0	0	0	0	0	0	0	0	0	3
Total	**12**	**15**		**12**						**12**			**15**		**12**
Average	**3**	**3**		**3**						**3**			**3**		**3**

COs and POs and COs and PSOs on the scale of 0 to 3, 0 being no correlation,

1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 – $\mathbf{0} \leq \boldsymbol{C} \leq 5\%$ – No correlation;

1 – $5 < \boldsymbol{C} \leq 40\%$ – Low / Slight;

2 − $40\ \% < \boldsymbol{C} < 60\%$ – Moderate.

3 – $60\% \leq \boldsymbol{C} < 100\%$ – Substantial / High