## III Semester

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>PEC321C</td>
<td>Research Methodology</td>
<td>4.0</td>
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<td><strong>Elective – V</strong></td>
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<tr>
<td>2</td>
<td>PEC313E</td>
<td>Digital Satellite Communication</td>
<td>4.0</td>
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<tr>
<td>3</td>
<td>PEC311E</td>
<td>Detection and Estimation Theory</td>
<td>4.0</td>
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<tr>
<td>4</td>
<td>PEC314E</td>
<td>Advanced Control Systems</td>
<td>4.0</td>
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<td>5</td>
<td>PEC314I</td>
<td>Industrial Training</td>
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<tr>
<td>6</td>
<td>PEC316P</td>
<td>Project Phase - I</td>
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<td><strong>Course Title:</strong> Research Methodology</td>
<td><strong>Course Code:</strong> PEC321C</td>
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<tr>
<td><strong>Credits:</strong> 4</td>
<td><strong>Teaching Hours:</strong> 52 Hrs (13 Hrs/Unit)</td>
<td><strong>Contact Hours:</strong> 4 Hrs/Week</td>
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<tr>
<td><strong>CIE Marks:</strong> 50</td>
<td><strong>SEE Marks:</strong> 50</td>
<td><strong>Total Marks:</strong> 100</td>
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**Department:** Electronics and Communication Engg.  
**Designation:** Core  
**Prerequisites:** ---

**Course Objectives:**
The objective of the course is to enable students to
1. Understand basic concepts of research and its methodologies  
2. Select and define appropriate research topic, problem and parameters  
3. Identify various sources of information for literature review and data collection  
4. Develop an understanding of various research designs and sampling techniques to conduct research  
5. Understand steps involved in writing a research report

**Course Outcomes:**
A student who successfully completes this course should be able to
1. Apply different research techniques to technical, business and management problems/ issues  
2. Demonstrate knowledge of survey done, data analysis and interpretation in relation to the research process  
3. Conceptualize the research process  
4. Develop necessary critical thinking skills in order to evaluate different research approaches  
5. Write a research proposal

*The topics that enable to meet the above objectives and course outcomes are given below:*

**Unit I (13 hours)**
Introduction: Meaning, objectives, types of research - descriptive Vs. analytical, applied Vs. fundamental, quantitative Vs. qualitative, conceptual Vs. empirical, significance of research, research methods Vs. methodology, research process, criteria of good research.
Defining the research problem: Conditions to define a research problem, selecting the problem, necessity of defining the problem, techniques involved in defining a problem.

**Unit II (13 hours)**
Research design: Meaning of research design, need for research design, features of good design, important concepts relating to research, different research designs, basic principles of experimental designs, important experimental designs.
### Unit III (13 hours)
Sampling design: Steps in sampling design, characteristics of a good sample design, types of sample designs, sample size and its determination.
Data collection: Methods of data collection, collection of primary data and secondary data, selection of appropriate method for data collection.

### Unit IV (13 hours)
Testing of hypothesis - Basic concepts, procedure for hypothesis testing, flow diagram for hypothesis testing, hypothesis testing for mean, proportion, variance, Chi-square test.
An Interpretation and report writing: Techniques of interpretation, precautions in interpretation, significance of report writing, different steps in writing report, layout of research report, types of reports, precautions for writing research reports.

### Reference Books

Course Title: Digital Satellite Communication  
Course Code: PEC313E  
Credits: 4  
Teaching Hours: 52 Hrs (13 Hrs/Unit)  
CIE Marks: 50  
Contact Hours: 4 Hrs/Week  
SEE Marks: 50  
Total Marks: 100  
Department: Electronics and Communication Engg.  
Designation: Elective  
Prerequisites: ---  

Course Objectives:  
1. The goal of the course is to introduce students to the fundamentals of satellite communication.  
2. To provide them with a sound understanding of how a satellite communication system successfully transfers information from one earth station to another.  
3. To expose them to examples of applications and tradeoffs that typically occur in UP/DOWN link system design, and to ask them to apply the knowledge in design problems.  
4. Provide in-depth understanding of modulation coding and multiple access techniques.  

Course Outcomes:  
1. How to describe the motion of satellite in the orbit. How to compute look angles and angle of visibility and consequently determine coverage area.  
2. How to calculate the received carrier power at the input of earth station receiver or satellite transponder.  
3. How to calculate the carrier to noise ratio at the input of earth station or satellite Transponder. To design both up-link and down link.  
4. Explain different modulation and coding schemes in satellite communication systems.  

The topics that enable to meet the above objectives and course outcomes are given below:  

**Unit I (13 hours)**  
Introduction: Origin of satellite communication, historical background, basic concepts of satellite communication, frequency allocation of satellite services, application, future trends of satellite communications Orbital mechanics and launchers: Orbital mechanics look angle determination, orbital perturbations, orbit determination, launches and launch vehicles, Orbital effects in communication systems performance Satellites: Satellite subsystems: Attitude and orbit control system, telemetry, tracking, command and monitoring, power systems, communication subsystems, satellite antennas equipment reliability and space qualification.  

**Unit II (13 hours)**  
Satellite link design: Satellite link design: Basic transmission theory, system noise temperature and G/T ratio, design of downlinks, uplink design, design of satellite links for specified C/N, system design example. Propagation Effects and their Impact on Satellite-Earth Links: Quantifying attenuation and Depolarization. Rain and Ice effects Propagation Impairment Countermeasures.
**Unit III (13 hours)**

Modulation, Multiplexing, Analog telephone transmission, FM theory, FM detector theory, Analog TV transmission, S/N ratio Calculation for satellite TV linking, Digital transmission, base band and band pass transmission of digital data, BPSK, QPSK, FDM, TDM, Multiple access Techniques: Introduction, frequency division multiple access (FDMA), intermodulation, calculation of C/N, Time division Multiple Access (TDMA), frame structure, examples, satellite switched TDMA onboard processing, DAMA, coding division multiple access, spread spectrum transmission and reception and Random access.

**Unit IV (13 hours)**


**Reference Books**

<table>
<thead>
<tr>
<th>Course Title: Detection and Estimation Theory</th>
<th>Course Code: PEC311E</th>
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<tbody>
<tr>
<td>Credits: 4</td>
<td>Teaching Hours: 52 Hrs (13 Hrs/Unit)</td>
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<td>Contact Hours: 4 Hrs/Week</td>
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<td>CIE Marks: 50</td>
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<td>Department : Electronics and Communication Engg.</td>
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<td>Designation: Elective</td>
<td>Prerequisites: ---</td>
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<tr>
<td><strong>Course Objectives:</strong></td>
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<tr>
<td>1. To acquire the fundamental concepts of signal detection and estimation.</td>
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<td>2. To expose the conceptual basics of Hypotheses.</td>
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<tr>
<td>3. To introduce the methods of Detection and estimation of signals in presence of noise.</td>
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<tr>
<td>4. To familiarize with the detection of random signals.</td>
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<tr>
<td>5. To understand the time varying waveform detection and its estimation</td>
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<tr>
<td><strong>Course Outcomes:</strong></td>
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<tr>
<td>A student who successfully completes this course will be able to</td>
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<tr>
<td>1. Demonstrate different decision criteria, Estimation techniques and their properties.</td>
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<td>2. Analyze complex engineering problems for conducting research in the field of detection and estimation of random signals.</td>
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<tr>
<td>4. Solve engineering problems in detection and estimation of continuous waveforms and obtain solution for design of optimum linear filters.</td>
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*The topics that enable to meet the above objectives and course outcomes are given below:*

**Unit I (13 hours)**

**Unit II (13 hours)**
<table>
<thead>
<tr>
<th>Unit III (13 hours)</th>
<th>Unit IV (13 hours)</th>
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**Reference Books**

Course Title: Advanced Control Systems

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<tr>
<th>Credits: 4</th>
<th>Teaching Hours: 52 Hrs (13 Hrs/Unit)</th>
<th>Course Code: PEC314E</th>
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| CIE Marks: 50 | SEE Marks: 50 | Total Marks: 100 |

Department : Electronics and Communication Engg.
Designation : Elective
Prerequisites : ---

Course Objectives:
The course is intended to provide the knowledge about
1. Fundamentals of state space analysis and state observer design of control systems.
2. The phase plane analysis of linear and non-linear systems
3. Describing function analysis of non-linear systems and stability analysis.
4. Time varying optimal control system and its estimation.

Course Outcomes:
A student who successfully completes this course should be able to
1. Comprehend the fundamentals of state space analysis and state observer design of control systems.
2. Analyze the phase plane analysis of linear and non-linear systems
3. Describe the function analysis of non-linear systems and stability analysis.
4. Estimate the Time varying optimal control system using LQR.

The topics that enable to meet the above objectives and course outcomes are given below:

**Unit I (13 hours)**
State Variable Analysis- Concept of state – State variable and state model, state models for linear and continuous time systems. Solution of state and output equation, controllability and observability - pole placement – state observer design of control systems with observers.

**Unit II (13 hours)**
## Unit III (13 hours)
Describing Function Analysis: Basic concepts, derivation of describing functions for common non-linearities, describing function analysis of non-linear systems, conditions for stability, stability of oscillations.
Stability Analysis: Introduction, Liapunov’s stability concept, Liapunov’s direct method, Lure’s transformation, Aizerman’s and Kalman’s conjecture, Popov’s criterion, circle criterion.

## Unit IV (13 hours)
Optimal Control: Introduction, decoupling, time varying optimal control, LQR steady state optimal control, optimal estimation, multivariable control design.

### Reference Books

<table>
<thead>
<tr>
<th>Course Title: Industrial Training</th>
<th>Course Code: PEC314I</th>
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<td>Credits: 4</td>
<td>Teaching Hours: ---</td>
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<td>Total Marks: 100</td>
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Department: Electronics and Communication Engg.
Designation: Term Work
Prerequisites: ---

Course Objective:
To give industry exposure

Course Outcome:
Student should be confident to cope with the changing demands of the industry.

CIE: Evaluated for 50 marks by the concerned guide based on the qualitative and quantitative assessment of the work done by the candidate and the report submitted by the candidate.

SEE: Evaluated for 50 marks by a committee comprising of PG coordinator, HOD/nominee, and concerned guide based on the qualitative and quantitative assessment of the work done by the candidate, the report submitted by the candidate, presentation of the work done, and oral examination.
**Course Title:** Project Phase - I  
**Course Code:** PEC316P

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<tr>
<td>CIE Marks: 50</td>
<td>SEE Marks: 50</td>
<td>Total Marks: 100</td>
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</table>

**Department:** Electronics and Communication Engg.  
**Designation:** Project Work  
**Prerequisites:** ---

**Course Objective:**
To give exposure to the research oriented problems and provide optimal solutions

**Course Outcomes:**
A student who successfully completes this course should be able to Provide the solutions to research oriented problems.

CIE: Evaluated for 50 marks by the concerned guide based on the qualitative and quantitative assessment of the work done by the candidate and the report submitted by the candidate.

SEE: Evaluated for 50 marks by a committee comprising of PG coordinator, HOD/nominee, and concerned guide based on the qualitative and quantitative assessment of the work done by the candidate, the report submitted by the candidate, presentation of the work done, and oral examination.