

**NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI**  
**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

| <b><u>COURSE PLAN – PART I</u></b>  |   |                       |                            |
|---|---|-----------------------|----------------------------|
| <b>Program &amp; Specialization</b>   | B.Tech - Electrical and Electronics Engineering   |                       |                            |
| <b>Course Title</b>   | Control Systems   |                       |                            |
| <b>Course Code</b>  | EEPC 20   | <b>No. of Credits</b> | 04                         |
| <b>Department</b>   | Electrical and Electronics Engineering  | <b>Faculty</b>        | Dr. Vivek Mohan            |
| <b>Session:</b>   | July 2018   | <b>Section:</b>       | 3 <sup>rd</sup> year EEE-A |
| <b>Pre-requisite Course</b>   | MAIR 32   |                       |                            |
| <b>Course Coordinator</b>   | --  |                       |                            |
| <b>E-mail</b>   | vivekmohan@nitt.edu   | <b>Telephone No.</b>  | 8113093716                 |
| <b>Course Type</b>  | <input checked="" type="checkbox"/> Core course <input type="checkbox"/> Elective course <input type="checkbox"/> Laboratory course |                       |                            |
| <b>SYLLABUS (APPROVED BY BOS)</b>   |   |                       |                            |
| <p>Modelling of physical systems: Electrical systems - Electromechanical systems – Mechanical systems – Thermal systems.</p> <p>Time domain analysis: Time-domain specifications - Generalized error series – various test signals and its importance- Routh-Hurwitz stability criterion.</p> <p>Root Locus Technique: Definitions - Root locus diagram - Rules to construct root loci - Effect of polezero additions on the root loci.</p> <p>Frequency domain analysis: Bode plot - Polar plot - Nyquist plot - phase-margin - gain margin – Nyquist stability criterion.</p> <p>Controller design: Design of P, PI, PID, lag, lead, lead-lag compensator design.</p> |   |                       |                            |
| <b>ESSENTIAL READINGS : Textbooks, reference books, Website addresses, journals, etc</b>  |   |                       |                            |
| 1) Katsuhiko Ogata, 'Modern Control Engineering', Pearson Education<br>2) Nagrath and Gopal, 'Control Systems Engineering', New Age International<br>3) Benjamin C Kuo and Farid Golnaraghi, 'Automatic Control Systems', John Wiley and Sons<br>4) M. Gopal, 'Control Systems', Tata McGrawHill  |   |                       |                            |

## COURSE OBJECTIVES

To equip students with fundamentals of control systems

## COURSE OUTCOMES (CO)

### Course Outcomes

The students will be able to 1) understand the concepts of closed loop control systems 2) analyze the stability of closed loop control systems 3) apply the techniques to any electrical systems 4) design the classical controllers for electrical systems.

### Aligned Programme Outcomes (PO)

| COs/POs                | Course Outcomes (COs) |   |   |   |   |
|------------------------|-----------------------|---|---|---|---|
|                        | 1                     | 2 | 3 | 4 |   |
| Program Outcomes (POs) | 1                     | M | H | L | M |
|                        | 2                     | M | H | L | M |
|                        | 3                     | M | H | L | M |
|                        | 4                     | M | H | L | M |
|                        | 5                     | M | H | L | M |
|                        | 6                     | M | H | L | M |
|                        | 7                     | M | H | L | M |
|                        | 8                     | M | H | L | M |
|                        | 9                     | M | H | L | M |
|                        | 10                    | M | H | L | M |
|                        | 11                    | M | H | L | M |
|                        | 12                    | M | H | L | M |
|                        | 13                    | M | H | L | M |
|                        | 14                    | M | H | L | M |

## COURSE PLAN – PART II

### COURSE OVERVIEW

This is a basic course on control systems involving time domain, frequency domain and stability analyses of systems along with their controller design.

### COURSE TEACHING AND LEARNING ACTIVITIES

| S. No. | Week                                | Topic  | Mode of Delivery |
|--------|-------------------------------------|--|------------------|
| 1.     | 2 <sup>nd</sup> Week of July (4hrs) | Introduction to Control Systems with Examples                            | PPT/Chalk & Talk |
| 2.     | 3 <sup>rd</sup> Week of July (4hrs) | Modeling of Physical Systems (Electrical, Mechanical, Thermal)           | PPT/Chalk & Talk |
| 3.     | 4 <sup>th</sup> Week of July (4hrs) | Intro to Time Domain Analysis, Generalized Error Series and Test Signals | PPT/Chalk & Talk |

|     |  |   |                  |
|-----|--|---|------------------|
| 4.  | 5 <sup>th</sup> Week of July<br>(2hrs)     | Routh Hurwitz Stability Criterion                                     | PPT/Chalk & Talk |
| 5.  | 1 <sup>st</sup> Week of August<br>(3hrs)   | Routh Hurwitz continued + 1 <sup>st</sup> Cycle Test                  | PPT/Chalk & Talk |
| 6.  | 2 <sup>nd</sup> Week of August<br>(4hrs)   | Root Locus Technique  | PPT/Chalk & Talk |
| 7.  | 3 <sup>rd</sup> Week of August<br>(3hrs)   | Intro to Frequency Domain Analysis                                    | PPT/Chalk & Talk |
| 8.  | 4 <sup>th</sup> Week of August<br>(3hrs)   | Bode Plot   | PPT/Chalk & Talk |
| 9.  | 5 <sup>th</sup> Week of August<br>(4hrs)   | Bode Plot Continued   | PPT/Chalk & Talk |
| 10. | 1 <sup>st</sup> Week of Sept<br>(4hrs)     | Polar and Nyquist Plot  | PPT/Chalk & Talk |
| 11. | 2 <sup>nd</sup> Week of Sept<br>(2hrs)     | Polar and Nyquist Plot Continued                                      | PPT/Chalk & Talk |
| 12. | 3 <sup>rd</sup> Week of Sept<br>(3hrs)     | Revision of Frequency Domain Analysis + 2 <sup>nd</sup><br>Cycle Test | PPT/Chalk & Talk |
| 13. | 4 <sup>th</sup> Week of Sept<br>(4hrs)     | Intro to Controller Design and PI                                     | PPT/Chalk & Talk |
| 14. | 1 <sup>st</sup> Week of October<br>(3hrs)  | PI and PID continued  | PPT/Chalk & Talk |
| 15. | 2 <sup>nd</sup> Week of October<br>(4hrs)  | Compensator Designs   | PPT/Chalk & Talk |
| 16. | 3 <sup>rd</sup> Week of October<br>(3hrs)  | Compensator Designs Continued – Lead-Lag                              | PPT/Chalk & Talk |
| 17. | 4 <sup>th</sup> Week of October<br>(4hrs)  | Numerical Solving/Tutorial/Quiz                                       | PPT/Chalk & Talk |
| 18. | 5 <sup>th</sup> Week of October<br>(2hrs)  | Numerical Solving/Tutorial/Quiz                                       | PPT/Chalk & Talk |
| 19. | 2 <sup>nd</sup> Week of<br>November (2hrs) | Compensation Test   |                  |
| 20. | 3 <sup>rd</sup> Week of November<br>(2hrs) | End Sem Exam  |                  |

## COURSE ASSESSMENT METHODS

| S. No. | Mode of Assessment   | Week/Date                                     | Duration | % Weightage |
|--------|--|---|----------|-------------|
| 1.     | First cycle test<br>(1 <sup>st</sup> and 2 <sup>nd</sup> Modules)  | 1 <sup>st</sup> week of August                | 1 hour   | 25%         |
| 2.     | Second cycle test<br>(3 <sup>rd</sup> and 4 <sup>th</sup> Modules) | 3 <sup>rd</sup> Week of September             | 1 hour   | 25%         |
| 3.     | Tutorial/Quiz  | Throughout the semester                       | -        | 10%         |
| CPA    | Compensation test<br>(Full Portions)                               | 2 <sup>nd</sup> Week of November              | 1 hour   | 25%         |
| 4.     | End Semester<br>Examination  | 11 <sup>th</sup> to 22 <sup>nd</sup> December | 3 hours  | 40%         |

## COURSE EXIT SURVEY

1. Students feedback through class committee meetings
2. Feedback from students on the course outcomes shall be obtained at the end of the course

## COURSE POLICY

**COMPENSATION ASSESSMENT:** Attending all the assessments (1, 2, 3 & 5) are mandatory for every student. If any student fails to attend the assessment 1 or 2 or both due to genuine reason like medical emergency, the student may be permitted to appear the compensation assessment (CPA) on submission of appropriate documents as proof. The compensation assessment (CPA) will cover full syllabus. CPA is not considered as an improvement test.

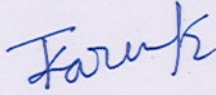
**ATTENDANCE POLICY:** All the students are expected to attend all the contact hours. Students should maintain 75% minimum physical attendance by the end of the course to attend the end semester examination. Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' Grade and will have to REDO the course. A maximum of 10% attendance shall be allowed under On Duty (OD) category. OD is allowed only for the students having minimum attendance of 65%.

**ACADEMIC HONESTY & PLAGIARISM:** In case of any student found guilty indulging in any mal practice, the student will be awarded no marks in that assessment. If found using mobile phones or any other gadgets for mal-practice during the examination, the answer sheet of the student will not be evaluated and will be awarded ZERO marks.

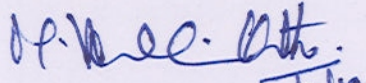
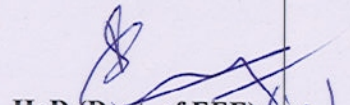
**MODE OF COMMUNICATION:** The Faculty is available for consultation during the time intimated to the students then and there. The lecture notes will be given through email of class representative or through the faculty homepage <https://sites.google.com/view/vivekmohan/lecture-notes>. For correspondence, please contact [vivekmohan@nitt.edu](mailto:vivekmohan@nitt.edu).

**FOR APPROVAL**

For



[Dr. Vivek Mohan, AP/EEE]  
Course Faculty

  
Course Coordinator  
HoD (Dept. of EEE) (ra)