| Course code | Course Name | L-T-P -Credits | Year of Introduction |
|---|---|---|---|
| EE484 | Control Systems | 3-0-0-3 | 2016 |

**Prerequisite : Nil**

**Course Objectives**

- To know Mathematical modelling of physical systems.
- To impart sound knowledge on different control equipment.
- To analyse systems using mathematical model.

**Syllabus**

Linear Time Invariant systems: Open loop-and closed loop control systems, Transfer function: Mechanical, Electromechanical systems. block diagram representation, signal flow graph. Control system components. Time domain analysis of control systems. PID controllers, Concept of stability, Frequency domain analysis, Introduction to State space.

**Expected outcome**.

The students will be able to

i. Model systems in transfer function and state space domain and
ii. Analyse stability of linear time invariant systems.

**Text Books:**

1. Katsuhiko Ogata, "Modern Control Engineering", Fourth edition, Pearson Education, New Delhi, 2002.
2. Nagarath I.J. and Gopal M., "Control System Engineering", Wiley Eastern, New Delhi.
3. Richard C. Dorf, Robert. H. Bishop, "Modern Control Systems", Pearson Education, New Delhi, 11th Edition, 2007.

**References:**

1. Gibson & Tutter, "Control System Components", Mc Graw Hill.
2. Kuo B.C., "Automatic Control Systems", Prentice Hall of India, New Delhi, sixth edition, 1991.
3. Norman S. Nise ,"Control Systems Engineering", 5th Edition, Wiley Eastern, 2007.

**Course Plan**

| Module | Contents | Hours | Sem. Exam Marks |
|---|---|---|---|
| I | Open loop-and closed loop control systems: Transfer function -T.F of simple linear time invariant systems - Mechanical and Electromechanical systems – Force voltage and force current analogy - block diagram representation - block diagram reduction - signal flow graph - Mason's gain formula - characteristics equation. | 9 | 15% |
| II | Control system components: DC and AC servo motor – synchro - magnetic amplifier - gyroscope - stepper motor - Tacho meter. | 5 | 15% |
| | **FIRST INTERNAL EXAMINATION** | | |
| III | Time domain analysis of control systems: Transient and steady state responses - test signals - time domain specifications - first and second order systems - impulse and step responses - steady state error analysis - static error coefficient of type 0,1,2 systems - Dynamic error coefficients | 7 | 15% |
| IV | PID controllers, Concept of stability: stability of feedback system - Routh's stability criterion - Root locus -General rules for constructing Root loci - effect of addition of poles and zeros. | 7 | 15% |
| | **SECOND INTERNAL EXAMINATION** | | |
| V | Frequency domain analysis: Introduction - Bode plot -Polar plot- gain margin - phase margin. | 6 | 20% |

| | | | |
|---|---|---|---|
| **VI** | Introduction to state space: State concept, state equation of simple systems, physical and phase variables, Eigen value and eigenvectors, conversion of state space model to transfer function. | 8 | 20% |
| **END SEMESTER EXAM** | | | |

**QUESTION PAPER PATTERN:**

Maximum Marks: 100 Exam Duration: 3Hourrs.

**Part A**: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

**Part B**: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part C**: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part D**: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.