Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electrical and Electronics Engineering
BEE050PROCESS CONTROL ENGINEERING
BEE050 Process Control Engineering
Eighth Semester, (even Semester)

Course (catalog) description

To enable the students to learn the basic concepts of process control and to develop sufficient knowledge of the various control actions and design of controllers used to control any process

Compulsory/Elective Course: Elective for EEE students

Credit & Contact hours : 3 and 45 hours

Course Coordinator : Mr.K.S.S.PRASAD

Instructors **:**Mr.K.S.S.PRASAD

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Mr.K.S.S.PRASAD	Second year EEE	KS 101	**04422290125**	Hod.eee@**bharathuniv.ac.in**	9.00-9.50 AM

Relationship to other courses:

Pre –requisites **:**BEE501- Control System

Assumed knowledge :To get basic knowledge of process control and design.

Syllabus Contents

UNIT I MATHEMATICAL MODELLING OF PROCESS 9

Process control introduction – Need for process control –Hardware elements of a process control system – Need of Mathematical modelling –Mathematical model of level, pressure ,thermal processes and interacting and non-interacting systems– Servo and Regulator Operation – Batch & Continuous Process – Concept of self regulation– x.

UNIT II VARIOUS CONTROLLERS AND ITS CHARACTERSTICS 9

Characteristics of ON- OFF, Single speed floating and PID controllers – Response of P,PI and PID controllers to various type of error signals – Analysis of Servo and Regulatory response of P and PI and PID controllers for first order and second order process – Reset Wind-up and prevention – Derivative and Proportional kick –Bumpless transfer – Selection of a controller for a particular process

UNIT III CONTROLLER DESIGN 9

Need for controller tuning –Evaluation criteria - Quarter Decay Ratio, IAE, ISE and ITAE– Optimum controller tuning using Evaluation criteria–Tuning of PID controllers using Process reaction curve method, Damped oscillation method and Z-N tuning method.

UNIT IV FINAL CONTROL ELEMENTS 9

I/P, P/I converters – Final control elements - Pneumatic and electric actuators -Types of control valves - Valve positioner and its importance - Inherent and Installed characteristics of control valve - Control valve sizing - Cavitation and flashing.

UNIT V MULTILOOP CONTROL 9

Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range and introduction to multivariable control – Examples from distillation column and boiler systems – IMC– Model Predictive Control – Adaptive control – P&ID diagram.

Text book(s) and/or required materials

1. Stephanopoulos. G, "Chemical Process Control - An Introduction to Theory and Practice", Prentice Hall of India, 2005.
2. Johnson .C.D, "Process Control Instrument Technology", Prentice Hall Inc., 2004.

Computer usage:

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	0%
Non major elective	-	100%

Broad area :

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	September 2nd week	Session 15 to 28	2 Periods
3	Model Test	October 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

To enable the students to learn the basic concepts of process control and to develop sufficient knowledge of the various control actions and design of controllers used to control any process	Correlates to program outcome		
	H	**M**	**L**
1. Learn the basic control actions and. Compute the Mathematical Model for different process	a, b,i	l	c,e
2. Analyse the characteristics of different types of Controllers and selection of controller	b	a,c,i,l	e
3. Select ,design and tune a controller to suit a particular process	b, c,i	a,e,l	
4.Identify the basic components of a final control element and distinguish the different Characteristics of control valve	a	b,c,i,l	e
5.Understand and analyze the concept of multi loop control techniques		a,b,e,i,l	c

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I			
1.	Process control introduction	NO	T1
2.	Need for process control	NO	
3.	Hardware elements of a process control system	NO	
4.	Need of Mathematical modelling	NO	
5.	Mathematical model of level, pressure ,thermal processes and interacting and non-interacting systems	YES	
6.	Servo and Regulator Operation	NO	
7.	Batch & Continuous Process	NO	
8.	Concept of self regulation	NO	
9.	Dead time,Degrees of freedom ,Linearization	NO	
UNIT II			
10.	Characteristics of ON- OFF, Single speed floating and PID controllers	NO	T1
11.	Response of P,PI and PID controllers to various type of error signals	YES	
12.	Analysis of Servo and Regulatory response of P and PI and PID controllers for first order process	NO	
13.	Analysis of Servo and Regulatory response of P and PI and PID controllers for second order process	NO	
14.	Derivative and Proportional kick	NO	
15.	Bumpless transfer	NO	
16.	Selection of a controller for a particular process	NO	
17.	Reset Wind-up and prevention	No	
18.	Revision	No	
UNIT III			
19.	Need for controller tuning	NO	T1
20.	Evaluation criteria	NO	
21.	IAE, ISE and ITAE– Optimum controller tuning using Evaluation criteria	NO	
22.	Tuning of PID controllers using Process reaction curve method, and Z-N tuning method.	NO	
23.	Tuning of PID controllers using Damped oscillation method	No	

24.	Tuning of PID controllers using Damped oscillation method	No	
25.	Tuning of PID controllers using Z-N tuning method.	No	
26.	Tuning of PID controllers using Z-N tuning method.	No	
27.	Quarter Decay Ratio	No	
UNIT IV			
28.	I/P, P/I converters	NO	T2
29.	Final control elements	NO	
30.	Pneumatic and electric actuators	NO	
31.	Valve positioner and its importance	NO	
32.	Inherent and Installed characteristics of control valve	NO	
33.	Inherent and Installed characteristics of control valve	NO	
34.	Control valve sizing	NO	
35.	Control valve sizing	NO	
36.	Cavitation and flashing.	NO	
UNIT V			
37.	Feed-forward control	NO	
38.	Ratio control ,Cascade control	NO	
39.	Inferential control	NO	
40.	Split-range and introduction to multivariable control	NO	
41.	Examples from distillation column and boiler systems	NO	
42.	IMC– Model Predictive Control	NO	
43.	IMC– Model Predictive Control	NO	
44.	Adaptive control,P&ID diagram	NO	
45.	Adaptive control,P&ID diagram	NO	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.

- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by: **Dated :**
Mr.K.S.S.PRASAD

Addendum

ABET Outcomes expected of graduates of B.Tech / EEE / program by the time that they graduate:

a) An ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) An ability to identify, formulate, and solve engineering problems.

c) An ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) An ability to design and conduct experiments, as well as to analyze and interpret data.

e) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) An ability to apply reasoning informed by the knowledge of contemporary issues.

g) An ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) An ability to understand professional and ethical responsibility and apply them in engineering practices.

i) An ability to function on multidisciplinary teams.

j) An ability to communicate effectively with the engineering community and with society at large.

k) An ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) An ability to recognize the need for,and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION
Electrical Engineering Graduates are in position with the knowledge of Basic Sciences in general and Electrical Engineering in particular so as to impart the necessary skill to analyze and synthesize electrical circuits, algorithms and complex apparatus.

PEO2: CORE COMPETENCE
Electrical Engineering Graduates have competence to provide technical knowledge, skill and also to identify, comprehend and solve problems in industry, research and academics related to power, information and electronics hardware.

PEO3: PROFESSIONALISM
Electrical Engineering Graduates are successfully work in various Industrial and Government organizations, both at the National and International level, with professional competence and ethical administrative acumen so as to be able to handle critical situations and meet deadlines.

PEO4: SKILL
Electrical Engineering Graduates have better opportunity to become a future researchers/ scientists with good communication skills so that they may be both good team-members and leaders with innovative ideas for a sustainable development.

PEO5: ETHICS
Electrical Engineering Graduates are framed to improve their technical and intellectual capabilities through life-long learning process with ethical feeling so as to become good teachers, either in a class or to juniors in industry.

Course Teacher	Signature
Mr.K.S.S.PRASAD	

Course Coordinator
(Mr.K.S.S.PRASAD)

HOD/EEE
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