NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF CHEMICAL ENGINEERING

Amended Course Plan (Due to Covid 19)

COURSE PLAN – PART I			
Name of the programme and specialization	**B.Tech. Chemical Engineering**		
Course Title	**PROCESS DYNAMICS AND CONTROL**		
Course Code	CLPC25	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	CLIR10		
Session	**Jan. 2020**	**Section (if, applicable)**	**NA**
Name of Faculty	**Dr. T.K.Radhakrishnan**	**Department**	**Chemical Engg.**
Official Email	**radha@nitt.edu**	**Telephone No.**	**0431 2503104**
Name of Course Coordinator(s) (if, applicable)	**NA**		
Official E-mail	**NA**	**Telephone No.**	
Course Type (please tick appropriately)	☑ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)

Introduction - Control system, components of a feedback control system, Lags in the control system – transfer lag, transportation lag, pneumatic PID controller, control valve – valve characteristics.

Laplace transforms - properties of Laplace transform, solution of linear differential equations using Laplace transform techniques, piecewise continuous functions

Dynamic behaviour of systems - derivation of transfer functions for first and second order systems, liquid level, temperature, pressure, flow and concentration control processes, linearization of nonlinear systems, interacting and non-interacting systems.

Transient response of first and second order systems, natural frequency, damping factor, overshoot, decay ratio, rise time and settling time.
Transient analysis of control systems - block diagram algebra, overall transfer function of closed loop control systems, regulator and servo problems, transient response of first and second order systems with P, PI and PID controller.

Definition of stability of control systems, Routh test, limitations of Routh test, Pade's approximation of time delay systems.

Introduction to frequency response - Bode diagrams, Bode diagrams for first and second order systems, P, PI, PID controllers, transportation lag. Bode stability criteria, phase margin and gain margin, Nichols chart, Ziegler - Nichols Optimum controller settings. Nyquist stability criteria, calculation of phase margin, gain margin, peak gain and resonant frequency using Nyquist plot.

COURSE OBJECTIVES
1. To introduce students to the terminology, concepts and practices of input/output modeling and automatic process control. To impart knowledge in the design of control systems and controller tuning for chemical processes

MAPPING OF COs with POs	
Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
1. Construct a model of the chemical processes and other elements used in feedback control systems from first principles leading to the development of transfer function models	PO1, PO2, PO3,PO4, PO5,PO8,PO9,PO11, PO12
2. Compute the response of the developed transfer function for various forcing functions providing an understanding of the transient response of the system	PO1, PO2, PO3,PO4, PO5,PO8,PO9,PO11, PO12
3. Derive transfer function models of controllers and compute the transient response under closed loop conditions.	PO1, PO2, PO3,PO4, PO5,PO8,PO9,PO11, PO12
4. Evaluate the stability of the control system given a mathematical model of a control system including its components.	PO1, PO2, PO3,PO4, PO5,PO8,PO9,PO11, PO12
5. Design a control system for robust performance using frequency response methods.	PO1, PO2, PO3,PO4, PO5,PO8,PO9,PO11, PO12

COURSE PLAN – PART II			
COURSE OVERVIEW			
The Process Dynamics and Control course is offered in the sixth semester to chemical engineering students. The subject has 3 credit theory weightage.			
COURSE TEACHING AND LEARNING ACTIVITIES			**(** Add more rows)
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1.	1st Week-6th Week (16 contact hours)	Introduction - Control system, components of a feedback control system. Laplace transforms - properties of Laplace transform, solution of linear differential equations using Laplace transform techniques, piecewise continuous functions. Dynamic behaviour of systems - derivation of transfer functions for first and second order systems, liquid level, temperature, pressure, flow and concentration control processes, linearization of nonlinear systems, interacting and non-interacting systems. Transient response of first and second order systems, natural frequency,	Chalk & Talk

	6th Week 7th Week	damping factor, overshoot, decay ratio, rise time and settling time. Assessment I Assignment/Seminar I	
2.	7th week-9th week (9 contact hours)	Transient analysis of control systems - block diagram algebra, overall transfer function of closed loop control systems, regulator and servo problems, transient response of first and second order systems with P, PI and PID controller.	Chalk & Talk
3.	9th week-10th week (7 contact hours) 10th week	Pneumatic PID controller, control valve – valve characteristics. Definition of stability of control systems, Routh test, limitations of Routh test, Pade's approximation of time delay systems. Assessment II	Chalk & Talk
4.	11th week 11th week-13th week (8 contact hours)	Assignment/Seminar II Introduction to frequency response - Bode diagrams, Bode diagrams for first and second order systems, P, PI, PID controllers, transportation lag. Bode stability criteria, phase margin and gain margin, Nichols chart, Ziegler - Nichols Optimum controller settings. Nyquist stability criteria, calculation of phase margin, gain margin, peak gain and resonant frequency using Nyquist plot.	Online classes, Doubt clearing session
5.	14th week End of semester	Compensation Assessment (CPA) Final Assessment	

COURSE ASSESSMENT METHODS (shall range from 4 to 6**) –Amended due to Covid-19**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment I	Feburary III Week	1 hour	20
2	Assignment (2 Nos.)	February II Week May Last Week		30
3	Assessment II	July III Week	1 hour	20
CPA	Compensation Assessment*	July IV Week	1 hour	20
4	Final Assessment *	End of semester	2 hours	30

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

Feedback from students during class committee meetings
Feedback during end semester examinations

COURSE POLICY (including compensation assessment to be specified**)**

MODE OF CORRESPONDENCE (email/ phone etc): The faculty is available for consultation the Department. Queries may also be emailed to the faculty directly at radha@nitt.edu

COMPENSATION ASSESSMENT

All the assessments are compulsory.

If a student fails to attend any one assessment due to genuine reasons, he/she will be permitted to appear for CPA. CPA may not be considered as an improvement test

Grading and passing minimum are as prescribed by the regulations of the institute.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

Textbooks, reference books Website addresses, journals, etc

1. *D.R. Coughanowr and S. E. LeBlanc, 'Process Systems Analysis and Control', Mc.Graw Hill, III Edition, 2009.*
2. *D. E. Seborg, T. F. Edger, D. A. Millichamp and F.J. Doyle III, 'Process Dynamics and Control', Wiley, III Edition, 2013.*
3. *C.A.Smith and A.B.Corripio, 'Principle and Practice of Automatic Process Control', John Wiley and Sons, III Edition, 2006.*
4. *W.L.Luyben, 'Process Modelling, Simulation and Control for Chemical Engineers'***,** *McGraw Hill, II Edition, 1990.*

FOR APPROVAL

Course Faculty **Dr. T.K.Radhakrishnan**	**CC-Chairperson** **Dr A Arunagiri**	**HoD** **Dr K M MEERA S. BEGUM**

The following amendments are made due to COVID 19:

All students shall be permitted to appear for end semester examination / final assessment. Attendance shall not be a criterion for preventing a student from appearing for final assessment. The final assessment shall not exceed 2- hour duration. Any online assessment, including the final one, shall not carry a weightage of more than 30%. In the Class Committee, it is decided to adjust the weightage amongst the internal assessments (IA) in such a way the total weightage attributed to IA is 70%. The details are given in course assessment methods.

For Approval		
Course Faculty **Dr. T.K.Radhakrishnan**	**CC-Chairperson** **Dr A Arunagiri**	**HoD** **Dr K M MEERA S. BEGUM**

Guidelines

a) The number of assessments for any theory course shall range from 4 to 6.

b) Every theory course shall have a final assessment on the entire syllabus with at least 30% weightage.

c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.

d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.

f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.

g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.