NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ICE

COURSE PLAN – PART I			
Name of the programme and specialization	M.Tech – Process Control and Instrumentation		
Course Title	System Identification and Adaptive Control		
Course Code	CL666	No. of Credits	3
Course Code of Pre-requisite subject(s)	NIL		
Session	January 2021	Section (if, applicable)	NA
Name of Faculty	Dr. D. Ezhilarasi	Department	ICE
Official Email	ezhil@nitt.edu	Telephone No.	9444878908
Name of Course Coordinator(s) (if, applicable)			
Official E-mail		Telephone No.	
Course Type (please tick appropriately)	☐ Core course	■ Elective course	

Syllabus (approved in BoS)

Course Content:

Introduction to system identification: identification based on differential equations, Laplace transforms, frequency responses, difference equations. Signals and system concepts, stationarity, auto-correlation, cross-correlation, power spectra. Random and deterministic signals for system identification: pulse, step, pseudo random binary sequence (PRBS).

Nonparametric model estimation: Correlation and spectral analysis for non-parametric model identification, obtaining estimates of the plant impulse, step and frequency responses from identification data.

Prediction-Error Model Structures: Parametric estimation using one-step ahead prediction error model structures and estimation techniques for ARX, ARMAX, Box-Jenkins, FIR, Output Error models. Residual analysis for determining adequacy of the estimated models.

Adaptive Control: Close loop and open loop adaptive control. Self-tuning controller. Auto tuning for PID controllers: Relay feedback, pattern recognition, correlation technique.

Adaptive Smith predictor control: Auto-tuning and self-tuning Smith predictor. Adaptive advanced control: Pole placement control, minimum variance control, generalized predictive control.

TEXT BOOKS: 1. O.Nelles, Nonlinear System Identification, Springer-Verlag, Berlin, 2001. 2. Y.Zhu, Multivariable System Identification for Process Control, Pergamon, 2001. 3. L.Ljung, System Identification: Theory for the User, 2nd Edition, Prentice-Hall, 1999. 4. B.A. Ogunnaike and W.H. Ray, Process Dynamics, Modeling, and Control, Oxford University Press.

COURSE OBJECTIVES	
Expose students to the system identification and adaptive control methods used in industries and for research	
MAPPING OF COs with POs	
Course Outcomes **Upon completing the course, the student should have understood**	**Programme Outcomes (PO)** (Enter Numbers only)
1. Identification Methods	1,2,3,4,5,6,7,8,9,10,12
2. Estimation of Nonparametric models	1,2,3,4,5,6,7,8,9,10,12
3. Prediction-Error Model Structures	1,2,3,4,5,6,7,8,9,10,12
4. Adaptive control schemes	1,2,3,4,5,6,7,8,9,10,12

COURSE PLAN – PART II

COURSE OVERVIEW

This course is offered to graduates and includes topics such as mathematical models of systems from observations of their behavior; time series, state-space, and input-output models; model structures, parametrization, and identifiability, structure determination; order estimation;; non-parametric methods; prediction error methods for parameter estimation, convergence, consistency, and asymptotic distribution; relations to maximum likelihood estimation; recursive estimation; Adaptive control techniques.

COURSE TEACHING AND LEARNING ACTIVITIES

(Add more rows)

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	1st & 2nd Week/ 6 hours	Signals and system concepts Introduction to system identification: modelling of different processes, model classification, identification procedure, difference equations.	Online-OneNote
2	3rd & 4th Week/ 6 hours	Non parametric model identification, convolution, correlation technique-stationarity, auto-correlation, cross-correlation, power spectra. Random and deterministic signals for system identification: pulse, step, pseudo random binary sequence (PRBS).	Online-OneNote
3	5th & 6th Week/ 6 hours	Nonparametric model estimation: Correlation and spectral analysis for non-parametric model identification, obtaining estimates of the plant impulse, step and frequency responses from identification data.	Online-OneNote

4	7th & 8th Week/ 6 hours	Prediction-Error Model Structures: Parametric estimation using one-step ahead prediction error model structures.	Online-OneNote
5	9th & 10th Week/ 6 hours	Estimation techniques for ARX, ARMAX, Box-Jenkins, FIR, Output Error models. Residual analysis for determining adequacy of the estimated models. Recursive system Identification	Online-OneNote
6	11th & 12th Week/ 6 hours	Adaptive Control: Close loop and open loop adaptive control. Self-tuning controller. Auto tuning for PID controllers: Relay feedback, pattern recognition, correlation technique.	Online-OneNote
7	13th Week/ 3 hours	Adaptive Smith predictor control: Auto-tuning and self-tuning Smith predictor. Adaptive advanced control: Pole placement control, minimum variance control, generalized predictive control.	Seminar thru PPT

COURSE ASSESSMENT METHODS (shall range from 4 to 6**)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment 1 (Weekly Quiz)	Till 2nd week of Feb	NA	20%
2	Assessment 2 (Weekly Quiz)	Till 4th week of March	NA	20%
3	Assignment	2nd week of April	NA	15%
4	Mini Project	3rd Week of April	NA	15%
5	Final Assessment *	1st Week of May	2 Hour	30%

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

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

Written feedback from students on course outcome
Students' performance in tests

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

COMPENSATION ASSESSMENT : Compensation assessment will be conducted for students who miss Assessment 1 or Assessment 2. Students should get permission from the faculty by giving valid reason in written form to write compensation assessment.

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

FOR APPROVAL

Course Faculty _____ CC- Chairperson K Muthukumar 10.02.2021 _____ HOD _____

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.