National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2018-19**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EE414	**Nonlinear Control**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

After the completion of the course, the student should be:

Course Objectives		Course Outcomes		
	To introduce basic concepts, elements, terminologies of nonlinear systems and different control philosophy.		CO1	**able to acquire knowledge about nonlinear systems, feedback, optimal and adaptive controls.**
	To introduce the Calculus of Variations concept and controller design via. feedback and optimal control techniques.		CO2	**able to design nonlinear feedback control and to achieve stabilisation and regulation.**
	To discuss the concepts of controller design adaptive control technique.		CO3	**able to describe dynamic optimisation problems via. calculus of variations concept.**
			CO4	**able to determine the necessary conditions, optimum control input and solve constrained optimisation problem.**
			CO5	**able to design model reference adaptive control.**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	**3**	**2**	**1**	**0**	**2**	**2**	**2**	**0**	**0**	**2**	**0**	**2**	**1**	**1**	**1**
2	CO2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**0**	**1**	**0**	**2**	**3**	**2**	**2**
3	CO3	**2**	**3**	**2**	**3**	**1**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**3**	**2**	**3**
4	CO4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**3**	**2**
5	CO5	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Nonlinear Feedback Control and Stabilisation** Introduction to Nonlinear systems, Characteristics of nonlinear systems, Types of nonlinearities and their occurrence, Classification of equilibrium points, Limit cycles, Phase plane analysis. Analysis of feedback systems, Concepts of Inverse control, Feedback linearization, Simultaneous Feedback control, Design via. linearization, Stabilization and regulation via. Integral control and Gain scheduling, Exact Feedback Linearization, Input state linearization, Input output linearization, State feedback control, stabilization, tracking and integral control.	**10**	**CO1** **CO2**
II	**Introduction to Calculus of Variations** Calculus of variations approach, Maximization of functionals of a single and several independent functions, Euler-Lagrange Equation, Constrained extremals-extremal of functionals with dependent functions.	**09**	**CO1** **CO3**
III	**Variational Approach to Optimal Control** Optimal control problem, Performance measure, Optimal control problem formulation, Open loop and closed loop form of optimal control, Variational approach to solving optimal control problems, Necessary conditions and boundary conditions for optimal control using Hamiltonian, Closed loop control for linear regulator problem, Linear tracking problem, Pontryagin's minimum principle, State inequality constraints, Minimum time problems, Minimum control effort problems.	**10**	**CO1** **CO4**
IV	**Model Reference Adaptive Control** Model following control, Model reference adaptive control, Lyapunov function-based control design, Adaptive variable structure model following control.	**07**	**CO1** **CO5**
	Total Hours	**36**	

Essential Readings

1. J. J. E. Slotine and W. Li, "Applied Nonlinear Control", Prentice Hall International, New Jersey, 1991.
2. D. Subbaram Naidu, "Optimal Control Systems", CRC Press, London, 2002
3. E. Kirk, "Optimal Control Theory: An Introduction", Prentice-Hall International, 2004.

Supplementary Readings

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, India, 2017.
2. H. K. Khalil, "Nonlinear Systems", Prentice-Hall International, UK, 1996.
3. M. Krstic, P. V. Kokotovic and I. Kanellakopoulos, "Nonlinear and Adaptive Control Design", John Wiley and Sons, 1995.