GOVERNMENT COLLEGE OF ENGINEERING, JALGAON [M.S]

(An Autonomous Institute of Government of Maharashtra)

"Globally Accepted Engineers with Human Skills"

Curriculum for
M. Tech. Electrical Instrumentation and Control Engineering
2020-21

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester I of M. Tech. (Electrical Instrumentation and Control Engineering) with effect from academic year 2019-20

Course Code	Name of the Course	Group	Teaching Scheme*				Evaluation Scheme						Credit
							Theory			Practical		Total	
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN501	Modern Control Theory	PC	3	1	…	4	30	10	60	…	…	100	4
IN502	Nonlinear Dynamic Systems	PC	3	…	…	3	30	10	60	…	…	100	3
IN503	Electrical Drives and Control	PC	3	…	…	3	30	10	60	…	…	100	3
IN504	Professional Elective-I	PC	3	…	…	3	30	10	60	…	…	100	3
IN505	Professional Elective-II	PC	3	…	…	3	30	10	60	…	…	100	3
IN506	Research Methodology	BE	1	1	…	2	…	…	…	50	…	50	2
IN507	PG Lab I	PC	…	…	4	4	…	…	…	25	25	50	2
Total			16	2	4	22	150	50	300	75	25	600	20

Professional Elective-I		Professional Elective-II	
IN504A	Process Instrumentation	IN505A	Computer Aided Power System Analysis
IN504B	MOOC Course	IN505B	Transducer Technology
IN504C	Soft Computing Techniques	IN505C	Industrial Automation and Control

Note:
1. ESE (TH) duration is three hours.
2. MSE (TH) duration for all theory courses is two hours
3. Group indicates curriculum component . PC- Program Core, BE-Basic Engineering

IN501 MODERN CONTROL THEORY

Teaching Scheme: 03L+ 01 T; Total: 04 **Credits:** 04
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This is a course on modern control systems. This course is designed to provide students a thorough knowledge on linear control theory and its background. This course is suitable for first year PG students who are interested to work/research in the field of control theory, automation and its applications. In this course, various methodology of modelling in state space, state transition matrix and solution in state equation will be studied. Further, stability analysis issues in state space will be discussed. Finally, the concepts of controllability, observability, controller design, and observer design will also be discussed. The theory is supported by numerical examples, practical examples and Matlab programming.

DESIRABLE AWARENESS:

Knowledge of basic control systems and computer skills, modeling, and control strategies.

COURSE OBJECTIVES:

The objectives of offering this course are

1. To introduce and teach the concepts of state space representation of general and physical control systems, system analysis and associated terminologies.
2. To familiar students for the physical system in various forms of state space representation and its stability analysis.
3. To introduce significance of the controllability and observability.
4. To introduce and teach methods and techniques of state feedback gain and controller design.

COURSE OUTCOMES:

1. The students are exposed to an appropriate modern paradigm for the study of systems in state space approach, representation in state space forms from transfer function or differential equations of physical systems.
2. The students shall be able to analyze the systems in state space by obtaining solutions of forced and unforced state response of linear systems.
3. The student learns to implement modern control systems using a controllability and obsevability concepts.
4. The students are able to design state feedback gain, regulator and observer

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Use of state space systems for analysis and system representation	2, 3	Comprehension, Knowledge
CO2	Find the solutions for systems with forced or unforced input	1, 3	Analysis, Evaluation
CO3	Application and significance of controllability and observability	2, 3	Application, Evaluation
CO4	Controller design by pole placement and its application	1, 2	Creation, Synthesis

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2			1						1	1	1	1	
CO2	2	3		1	1										1
CO3					1		1							2	
CO4			2	2	1					1	2	2	2	2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

State Space Analysis

The Concept of State and State Models, State Diagram, State Space and State Trajectory, State Space Representation using Phase Variable and Canonical Variables, Solution of State Equation, State Transition Matrix and its Properties, Eigenvalues, Eigen Vectors, Model Matrix, Diagonalization, Generalized Eigenvectors, Computation of State Transition Matrix using Laplace Transformation, Power Series Method, Cayley-Hamilton Method, Similarity Transformation Method.

Representation of System in State Space

State space representation for electrical network, nth order differential equation, and transfer function. Conversion of transfer function to state model and vice versa. Modelling and representation of Mechanical Systems in State Space, Modelling and representation of DC Motor, Conversion of transfer function to state model and vice versa.

Stability

Internal or Lyapunov stability, Lyapunov stability theorem, Eigen value conditions for Lyapunov stability, Continuous and Discrete time cases, Input-Output stability: BIBO stability,Time domain conditions for BIBO stability. Frequency domain conditions for BIBO stability. BIBO versus Lyapunov stability.

Controllability and Stabilizability

Controllable and reachable subspaces, Physical examples and system interconnections, Reachabilty and controllability Grammians, Open loop minimum energy control, Controllabilty matrix(LTI), Eigen vector test for controllability, Lyapunov test for controllability, Controllable decomposition and block diagram interpretation, Stabilizable system, Eigen vector test for stabilizabilty, Feedback stabilization based on Lyapunov test.

Observabilty and Detectability

Unobservable and unconstructable subspaces, Physical examples, observabilty and Constructabilty Grammians, Gramian based reconstruction, Duality(LTI), Observable decompositions, Kalman decomposition theorem, Detectability, detectability tests, State estimation, Eigen value assignment by output injection, Stabilization through output feedback.

Control Design Technique

Controller Design by State Feedback, Necessary and Sufficient Condition for Arbitrary Pole Placement-State Regulator Problem and State Regulator Design, Evaluation of State Feedback Gain Matrix K,

Selection of Location of Desired Closed Loop Poles, State Observer Design, Full Order/Reduced Order Observer Design, Observer Based State Feedback Control.

Text books

1. Thomas Kailath, Linear Systems, Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
2. K. Ogata, Modern Control Engineering, (second edition), Prentice Hall Inc., Englewood Cliffs, N.J., 1990.
3. Chi-Tsong Chen, Linear System Theory and Design, Holt, Rinehart and Winston, 1970.

Ref. Books

1. R.C. Dorf, and R. T. Bishop, Modern Control Systems, Addison Wesley Longman Inc., 1999.
2. Eronini, Umez- Eronini, System Dynamics and Control, Thomson Asia Pt Ltd., Singapore, ISBN: 981-243-113-6, 2002.
3. W. S. Levine,, The Control Handbook, CRC press, 1996.
4. Brogan W. L., Modern Control theory, Prentice Hall International, New Jersey, 1990.
5. I. J. Nagarath and M. Gopal, Control system Engineering, New Age International (P) Ltd. 2013.

IN502 NONLINEAR DYNAMIC SYSTEMS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Physical systems are inherently nonlinear to a certain extent. Nonlinear control systems can be approximated by a linearized system. The subject of nonlinear control deals with the analysis and design of nonlinear control systems. From this subject student understand to nonlinearities in existing control systems, analysis of hard nonlinearities, model uncertainties. The students can acquire knowledge to design proper controller for given nonlinear dynamic system.

COURSE OBJECTIVES:

1. To make adequate use of basic mathematical tools to model, analyze, and design nonlinear dynamical systems.
2. Acquire knowledge on analysis of feedback systems having nonlinearity and explore tools for stability analysis.
3. Analysis and Design the controller for the nonlinear system using different tools.

DESIRABLE AWARENESS/SKILLS:

Nonlinear dynamic system, concepts of phase plane analysis, Lyapunov's stability, PR and SPR Transfer functions, Feedback Linearization

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Recognize significant nonlinearities in system and express them.	1, 2	Identify, Explain
CO2	Compute and analyze the performance and stability of the system.	3, 4	Apply, Analyze
CO3	Apply concept of phase plane analysis for nonlinear system	3, 4	Apply, Analyze
CO4	Derive and describe the feedback linearization	3, 4	Apply, Analyze.
CO5	Design and evaluate multi-input systems Sliding Control	4, 5	Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	3	1							1	2	2	
CO2	2	3	3	3	2	1						1	2	2	
CO3	1	2	3	3	2						1	1	3	2	

CO4	2	2	3	3	2						2	1	2	3	
CO5	1	2	3	3	2						1	2	2	2	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction: Nonlinear system behavior, nonlinear control, Examples pendulum equation, tunnel diode circuit, mass-spring system, negative resistance oscillator, adaptive control, Characteristics of nonlinear systems - classification of equilibrium points.

Nonlinear system analysis:

Phase plane analysis: Concepts of phase plane analysis, Singular Points, Phase plane analysis of linear and nonlinear systems, Existence of limit cycles. Methods of Constructing Phase Portraits: Analytical method, the method of Iscolines.

Fundamentals of Liapunov theory: Introduction, Nonlinear systems and equilibrium points, Autonomous and Non-autonomous systems, Concepts of stability, Linearization and local stability, Lyapunov's direct method, Invariant set theorems, Lyapunov analysis of LTI systems, Krasovskii's method, Variable gradient method, physically motivated Lyapunov functions, and Performance analysis. Control design based on Liapunov's direct method.

Advanced stability theory: Concepts of stability for Non-autonomous systems, Lyapunov analysis of non-autonomous systems, Lyapunov like analysis using Barbalat's Lemma, Positive linear system: PR and SPR transfer functions, The Kalman - Yakubovich Lemma, The Passivity formulation.

Nonlinear Control systems design: Feedback Linearization and the canonical form, Input-state Linearization of SISO systems, Input Output Linearization of SISO systems, multi-input systems Sliding Control: Sliding surfaces, Filippov's construction of the equivalent dynamics, direct implementations of switching control laws, Continuous approximations of switching control laws, modeling and performance trade-offs Lie derivative, Lie Bracket, Backstepping method for non-feedback linearizable systems.

Texts/References:

1. Jean- Jacques Slotine and Weiping Li, Applied nonlinear Control, Prentice-Hall,1991, ISBN: 0-13-040890.
2. H.K. Khalil, Nonlinear Systems, 3rd ed., Prentice hall, 2002.
3. D. Elliott, Bilinear Systems, Springer, 2009.
4. Shankar Sastry, Nonlinear Systems; Analysis, Stability and Control, Springer. 1999
5. P. LaSalle, Solomon Lefschetz, Stability by Liapunov's direct method: with applications, Joseph Academic Press, 1961
6. Mathukumalli Vidyasagar, Nonlinear syste.ms analysis, SIAM, 2002. 10
7. Alberto Isidori, Nonlinear Control Systems - Volume 1, Springer, 1995.
8. Alberto Isidori, Nonlinear Control Systems – Volume 2, Springer, 1999.

IN503 ELECTRICAL DRIVES AND CONTROL

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course gives opportunity to impart knowledge about fundamentals of Electric drives and control. To learn strategies and working principle of various power electronics circuits. It reviews electric drive system, electrical machines, power converters, ac and dc drives used in industries, control circuits and schemes for Industrial drives control.

COURSE OBJECTIVES:

1. Detailed knowledge of structure, operating principle of dc and ac machines, their characteristics and control.
2. To impart knowledge on the design and development of control methods for electric drive systems.
3. Overview on ac and dc drives and their control using power electronic circuits.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Apply power electronic circuits for the control of ac and dc drives and applications.	1, 3	Knowledge, Application,
CO2	Design suitable power electronic circuit for an electric drive system and analyse its steady state stability.	2, 3	Comprehension, Application,
CO3	Identify salient traits of the drives to incorporate the traits in their Projects.	3, 6	Application, Evaluation
CO4	Select appropriate control method for the electric drives.	4	Analysis
CO5	Design and implement a prototype drive system.	5, 6	Synthesis, Evaluation

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2						1		1		1				
CO2	2	1		1						1		1			2
CO3		1	3	2		2		1	2				1		
CO4					2	2									1
CO5			2		3					2		2		3	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated Course

Content

Electrical Drives

Components of electrical drives, electric machines, power converter and controllers, dynamics of electric drive, torque equation, equivalent values of drive parameters, components of load torque, types of load four quadrant operation of a motor, steady state stability analysis, load equalization, classes of motor duty, determination of motor rating.

DC motor

DC motors & their performance, braking, Transient analysis of separately excited motor, converter control of dc motors, analysis of chopper controlled dc drives, converter ratings and closed loop control, transfer function of self, separately excited DC motors, linear transfer function model of power converters, sensing and feedback elements, current and speed loops, P, PI and PID controllers, response comparison, simulation of converter and chopper fed DC drive.

Induction motor

Stator voltage control of induction motor, torque-slip characteristics, Operation with different types of loads, V/F control, Scalar and vector control of induction motor, Direct torque and flux control of induction motor, controlled current and controlled slip operation, effect of harmonics and control of harmonics, slip power recovery scheme.

Synchronous motor

Speed control of synchronous motors, adjustable frequency operation of synchronous motors, principles of synchronous motor control, voltage source inverter drive with open loop control, self-controlled synchronous motor with electronic commutation, self-controlled synchronous motor drive using load commutated thyristor inverter.

Industrial Drives and Control

Hybrid, variable reluctance, and PM stepper motors-performance characteristics and time response, full and half step motor drives, Switched reluctance motor drive, PMSM drives, BLDC drive and their control.

Reference Books:

1. Electric Motor Drives: Modeling, Analysis, and Control by R. Krishnan, Prentice Hall.
2. Fundamentals of Electrical Drives by G. K. Dubey, 2nd Edition, Narosa, 2009.
3. Modern Power Electronics and AC Drives by Bimal K Bose, Prentice Hall, 1st edition, 2002.
4. Electrical Motor Drives by R. Krishnan, PHI – 2001
5. Modern Power Electronics and AC Drives, by Bose, B.K., Pearson Education.
6. Power Electronics-Devices, Circuits and Industrial Applications, by Moorthi, V. R. Oxford University Press.
7. Permanent Magnet Synchronous and Brushless DC Motor Drives by Ramu Krishnan, CRC Press, 2017.

IN504A PROCESS INSTRUMENTATION
PROFESSIONAL ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The purpose of this course is to introduce the key concepts in automatic control and instrumentation of process plants. Elucidate necessity computerized control is important, identifies different ways in which precise control is ensured and illustrates the different set of instrumentation used to perform measuring tasks for temperature, pressure, flow and level.

DESIRABLE AWARENESS:

Laplace Transforms, Steady state analysis, solving ordinary differential equations and state space representation.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. Introduce basic fundamentals of advanced process control and their operation.
2. Elaborate different concepts of process control, mathematical modelling of process dynamics.
3. Analysis and investigations of the basic computer control schemes starting from sampling to discrete systems, development of pulse transfer functions
4. Familiar with discrete control systems. digital controllers and their design.
5. Introduce the students to advanced control strategies like internal model control, adaptive control and others.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	State the application of different transducers, calculation of errors in measurement and computer process control systems	1,2	Knowledge, Comprehension
CO2	Experimental determination of transfer functions of the sensors or systems.	2,4	Comprehension, Analysis.
CO3	Analyze application of digital controllers and interpret their benefits in the real time implementation.	3,4	Analysis, Application
CO4	Explore the constructional details, principle of operation, and performance of industrial unit operations and their Instrumentation.	1, 3, 4	Knowledge, Analysis, Application
CO5	Design and develop the advanced control loop, system identification and process modeling of nonlinear process.	4,5	Analysis, Synthesis

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	2	3	2	1					1	1		2	1	
CO2	2	3	2	2	1								2	1	1

CO3	1	2	1	2									1	2	
CO4	2	2	3	3									3	2	
CO5	2	2	3	3						1	2	2	3	3	2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content:

Process Dynamics Introduction to Process Control, Control Strategies, control Objectives, Benefits of Control, and importance of Control Engineering. Mathematical Modeling Principles - A Modeling Procedure, Modeling examples, Linearization. Dynamic behavior of typical process systems - Series structure of a simple systems, Parallel structure of a simple systems, Recycle structure, Staged processes, multiple-Input multiple-output systems, an empirical model building, process reaction curve.

Feedback Control and PID Tuning and Management Process and Instrument Elements of the Feedback Loop, Block Diagram, Control Performance Measures for Common Input Changes, Selection of Variables for Control. PID Controller Tuning for Dynamic Performance - Determining Tuning Constants for Good Control Performance, Correlations for Tuning Constants, Fine-Tuning the Controller Tuning Constants, Controller tuning based on stability –Dead beat and self tuning controller, Ziegler-Nichols Closed Loop, some important interpretations.

Digital Implementation in Process Control Structure of the Digital Control System, Effects of Sampling a continuous signal, The Discrete PID Control Algorithm, Effects of Digital control on stability, Tuning and performance. Practical Application of Feedback Control - Equipment Specification, Input Processing, Feedback Control Algorithm, Output Processing. Design of Digital Controllers: Digital approximation of classical controllers, Effect of sampling, Different class of digital controllers, Ringing and placement of poles, Design of optimal regulatory control systems, General synthesis method, Dahlin design, Kalman design, Predictive controller design, Internal-Model control

Design and Applications of Advanced Control Concepts: Process modelling and identification: Process modeling from step test data, pulse testing for process identification, Time domain process identification, Adaptive Control and Self Tuning: Gain scheduling, Model reference adaptive control, Self-tuning regulators, Feedforward Control: Introduction and design fundamentals, Some examples, Cascade Control: Controller design of cascade systems and industrial application, Multivariable Control Systems: Interaction analysis, Bristol's relative gain analysis, Singular value decomposition, Decoupling for non-interacting control, Model Predictive control.

Text books:

1. Computer-based Industrial Controls by Krishan Kant, 2nd edition, PHI India, New Delhi, 2004.
2. Computer Control of Process by M. Chidambaram, 1st edition, Narosha Publishing. 2005.
3. Automatic process control by D. Ekman, 2nd edition, Wiley Eastern Ltd, 2001.
4. Process control by Peter Harriot, 3rd edition, Tata McGraw hill, 2003.
5. Process control system Application, Design and tunning by F.G. Shinsky, 2nd edition, McGraw hill, 1999.
6. P. B. Deshpande and R. H. Ash, Computer Process Control with advanced control applications, 2nd edition, Instrument Society of America Publication, 1992.

Reference Books:

1. Process dynamics and control by Dale E. Seborg, Thoman F. Edgar, Dyncan A. Mellichamp, 2nd Edition, Willey publication, 2004.

2. Instruments Engineers Handbook Process Control,VoL-II by Bela G. Liptak, CRC Press, 4th edition, 2006.
3. R. Isermann, Digital Control Systems, Vol.I: Fundamentals, Deterministic Control, Springer-Verlag Publications, 2000.
4. Chemical Process Control: An Introduction to Theory and Practice by G. Stephanopoulos, Prentice-Hall of India, 1998.

IN504B MOOC COURSE
PROFESSIONAL ELECTIVE-I

Teaching Scheme: 00L+ 00 T; Total: 00 **Credits:** 03
Evaluation Scheme: 100 ESE **Total Marks:** 100
Reexamination ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Massive Open Online Courses (MOOCs) are online courses available for anyone to enroll with a view to providing access to the best quality learning resources across the country, the project 'Study Webs of Active Learning for Young Aspiring Minds' (SWAYAM) has been started by Ministry of Human Resource Development, Department of Higher Education, Government of India. SWAYAM provides an integrated platform and portal for online courses, using information and communication technology (ICT) and covering High School till all higher education subjects and skill sector courses to ensure that every student, benefits from learning material through ICT. An initiative under National Mission on Education through Information Communication Technology (NME-ICT) Programme, NPTEL developed e-content for many Courses of various Disciplines.

Students can opt for any one MOOC course from the list of courses approved by Departmental Faculty Board/Board of Studies

IN504C SOFT COMPUTING TECHNIQUES
PROFESSIONAL ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course introduces the student to soft computing techniques as a multidisciplinary field that requires a range of skills in statistics, mathematics, predictive modeling, analysis and their applications in engineering.

DESIRABLE AWARENESS:

Calculus, Linear Algebra, Statistics and Predominant Programming Language.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. Provide the most fundamental knowledge to the students so that they can understand intelligence techniques.
2. Identify problems where soft computing techniques are applicable.
3. Participate in the design of systems that act intelligently and learn from experience.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Able to define the expert system architecture and artificial intelligence (AI)	1,2	Knowledge, Comprehension
CO2	Recognize the feasibility of applying appropriate soft computing techniques for a given real world problem	1,2,3	Knowledge, Comprehension, Application
CO3	Examine the solution of problem based on of the basics of learning and training algorithms	4	Analysis
CO4	Develop engineering applications using neural network, fuzzy logic, genetic algorithm and hybrid system.	4,5	Analysis, Synthesis

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2		1	1	2	1					1	1	1	2	
CO2	1	2	1	2	2	1						1	3	1	
CO3	2	3	2	1	3	1							2	2	1
CO4	2	3	2	1							2	1	3	2	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content:

Artificial Intelligence: a Brief Review, Pitfalls of Traditional AI, Need for Computational Intelligence, Importance of Tolerance of Imprecision and Uncertainty, Constituent Techniques, Overview of Artificial Neural Networks, Fuzzy Logic, Evolutionary Computation.

Neural Network: Biological and Artificial Neuron, Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron, Multilayer Perceptron, Backpropagation Learning, Neural Networks as Associative Memories, Hopfield Networks, Bidirectional Associative Memory, Topologically Organized Neural Networks, Competitive Learning, Kohonen Maps.

Fuzzy Logic: Fuzzy Sets, Properties, Membership Functions, Fuzzy Operations, Fuzzy Inference System, Fuzzification and defuzzifications module, Scaling factors, Fuzzy controllers.

Genetic Algorithms: Introduction and concept, Coding, Reproduction, Cross Applications, Swarm intelligence, and their applications.

Evolutionary Computation: Overview of other Bio-inspired Algorithms - Swarm Intelligence Algorithms, Particle Swarm optimization, Ant Colony optimization, Grey-Wolf optimization, Hybrid systems: Neuro-fuzzy, Genetic-neuro, Genetic-fuzzy.

Text books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, by S. Rajasekaran and G. A. Vijayalakshmi Pai, 2nd Edition, PHI Learning, 2003.
2. Soft Computing: Neuro-Fuzzy and Genetic Algorithms by Samir Roy and Udit Chakraborty, 1st Edition, Pearson, 2006.

Reference books:

1. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, 3rd edition , Prentice-Hall International, 2000.
2. Introduction to Artificial Systems by J. M. Zurada, 5th Edition, Jaico Publishing House, 2004.
3. An Introduction to Neural Networks by James A. Anderson, 2nd edition , Prentice Hall of India, New Delhi, 1999.
4. An Introduction to Fuzzy Control by D. Drainkov, H. Hellendoorn and M. Reinfrank,, 6th edition , Springer-Verlag Berlin Heidelberg Publisher, 2008.
5. Fuzzy Logic with Engineering Applications by T. J. Ross, 3rd edition, MIT Press, Inc 2011.
6. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence by Kosko Bart, Prentice Hall of India, New Delhi, 2001.
7. An Introduction to Genetic Algorithms by Melanie Mitchell, 2nd Edition, MIT Press, 1999.

IN505A COMPUTER AIDED POWER SYSTEM ANALYSIS
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course covers introduction to modern power systems and its analyses. It addresses modelling issues and analysis methods for the power flow, short circuit, contingency and stability analyses, required to be carried out for the power systems. The details of numerical techniques to solve nonlinear algebraic as well as differential equations and handling of sparse matrices are included too.

COURSE OBJECTIVES:

1. Introduce computer applications in the analysis of power systems.
2. Understand the solution methods and techniques used in power system studies.
3. Overview of network formulation for stability studies for different types of loads in power systems.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Apply various concepts of analyses of Modern power modern system.	1, 3	Application,
CO2	Gain the ability to critically analyse the solution methods used in power system studies.	1, 2	Knowledge, Comprehension,
CO3	Design methodologies for simulation and analysis of power system networks like real and reactive power flows and optimal scheduling.	2, 6	Knowledge, Evaluation
CO4	Apply numerical techniques to solve nonlinear algebraic as well as differential equations for power system analyses.	3, 6	Application, Evaluation

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	1						1				1				
CO2		1		1					1	1		1		2	2
CO3			2	2	2	2		1	2				1		
CO4		1				3									1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Network Matrices

Evaluation of bus Admittance matrix (YBUS), Bus Impedance matrix (ZBUS), Branch Impedance matrix (ZBT) and Loop Admittance matrix (ZLOOP) by singular and nonsingular transformation

Short Circuit Studies

Formulation of ZBUS for single phase and three phase networks, transformation of network matrices using symmetrical components; short circuit studies using computer.

Load Flow Studies

Representation of off load and on load tap changing and phase shifting transformer and dc link, decoupled and fast decoupled methods, sparsity technique, introduction to load flow of integrated ac/dc/ system.

Stability Analysis

Network formulation for stability studies for different types of loads (constant impedance, constant current and constant power loads), digital computer solution of swing equation for single and multimachine cases using Runge-Kutta and predictor corrector method, effect of exciter and governor on transient stability.

Reference Books:

1. Computer methods in power system analysis by G.W. Stagg and A. H. El Abiad, McGraw Hill, 1971.
2. Computer aided power system analysis by G. L. Kusic, PHI, 1986.
3. Advanced power system analysis and dynamics L. P. Singh, Wiley Eastern.
4. Power system analysis by A W Bergen and V. Vittal, Prentice Hall, 2000.
5. Modern Power System Analysis by I. J. Nagrath and D. P. Kothari, Tata McGraw Hill, 1980.
6. Computer Techniques in Power Systems Analysis, M. A. Pai, Tata McGraw-Hill, Second edition 2005.

IN505B TRANSDUCER TECHNOLOGY
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The objective of this course is to make the students appreciate the principles of different types of transducers. Design the necessary signal conditioning circuit for different kinds of transducers. Make a proper selection of transducer as per the application. Get familiar with smart sensors and its applications..

COURSE OBJECTIVES:

1. The students shall take a review of different types of transducers and their working principles
2. Make students able to design a signal conditioning circuit for different transducers
3. Students shall get familiar with design of electromechanical system.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	make a selection of a transducer for given application	1,3	Knowledge, Application
CO2	design the signal conditioning circuit for different transducers	5	Synthesis
CO3	design electromechanical measurement system for certain application	3,4	Application ,Analysis
CO4	appreciate the idea of smart sensors and its working	4	Knowledge,
CO5	apply transducer for domestic or any specific application	3,4,5	Application, Evaluation, Synthesis

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	2	3	3	-	1	-	-	-	-	-	-	1	2	-	-
CO2	2	3	2	1	1	2	-	-	-	-	-	-	2	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	3	-
CO4	2	1	1	-	1	-	2	-	-	-	-	-	2	2	-
CO5	2	2	3	2	2	-	-	-	-	-	-	-	2	2	-

Course Content

Review of Transducers: Review of Fundamentals of Transducers for measurement process parameters like displacement, pressures, force, Flow, strain, velocity, speed, acceleration, vibration, torque, temperature, pH, conductivity, proximity sensors, environmental and chemical parameters etc.

Transducer signal conditioning: Concept of signal conditioning, signal level and bias changes, linearization, conversation, filtering and impedance matching, concept of loading, divider circuits, and bridge circuits, application of Boolean algebra, comparators, ADC, DAC, interference, grounding, and shielding. .

Design of Electromechanical Transducers: Force, Pressure, Stress, Vibration using, Strain-gauge, LVDT , Capacitive Elements, Optical Device, Design of Electromechanical Transducers for Torque, Flow and Velocity. Take typical application in each design case from Automobile for Torque, Liquid Flow for Flow and Velocity. Introduction to Chemical Sensors, Bio sensors, Gas Sensors, Fiber optic sensors and their applications.

Advanced sensor: SMART Sensors-Introduction, Primary sensors, Excitation, amplification, filters, converters, compensation, information coding/processing, data communication Recent trends in sensor technology: Introduction, Film sensors, semiconductor IC technology-standard methods, Microelectromechanical systems (MEMS), Nano sensors.

Sensor application: On board automobile sensors, home appliance sensors and aerospace sensors etc.

Texts books /References

1. Bella G Liptak, 'Instrument Engineer' Handbook, Vol 1,2 and 3', 3rdedition, (CRC Press) (2002).
2. 2. C.S. Rangan, G.R. Sarma and V.S.V. Mani 'Instrumentation Devices and Systems', Tata Mcgraw-Hill Publishing Company Ltd. New Delhi (1983).
3. 3. D. Patranabis, "Sensors and Transducers", 2nd Edition, (Prentice-Hall, India).
4. 4. E.O. Doebelin, 'Measurement Systems - Application and Design' ,Fourth edition, McGraw- Hill International Edition, New York
5. 5. Curtis D. Johnson, "Process control instrumentation technology" 8th ed. PHI learning Pvt. Ltd., 2010.5. J. Wilson, 'Optoelectronics', 2nd Edition, (Prentice-Hall, India) (1999).
6. 6. H K P Neubert, ' Instrument Transducers', (Oxford University Press) (1963)

IN505C INDUSTRIAL AUTOMATION AND CONTROL
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The broad knowledge of essential component of present industrial Automation Industry, human machine interface will enable the students to maintain the automation and control strategies used in the present industry.

COURSE OBJECTIVES:

1. To identify potential areas for automation and justify need for automation
2. To develop technologies where it can be used securely for industrial automation.
3. To expose the students to more advanced, precise and complex instrumentations which are being employed in the automation industry

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Understand the industrial automation systems	1,2	Remember,Understand
CO2	To develop models for industrial automation systems.	2,3	Understand,apply
CO3	Understand Controller tuning and applications	2,3,4	Understand,apply,analyze
CO4	Formulate and design sequence control	2,3	Understand,apply,
CO5	Understand process management and communication	3,4,5	apply,analyze,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	-	2	1	-	-	-	-	-	-	1	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	3	-
CO4	2	3	2	-	1	-	2	-	-	-	-	3	-	-	2
CO5	3	3	1	3	3	2	-	-	-	-	2	-	-	-	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Overview: Structure & components Industrial Automation systems. Architectural levels of Industrial controls.

Actuators & sensors: Servomotors, Stepper motors, Process I/O systems. Local & remote I/O systems.

Controllers: Different types of controllers, Single loop and Multiloop controllers and their tuning, Direct controllers and their tuning, Digital Controllers, Software implementation of Multi-loop Controllers. Distributed Control Systems.

Sequence Control: Programmable Logic Controllers, Relay Ladder Logic, Programming. Supervisory Controllers: Functionally of Supervisory Control Level, Process Optimization, Recipe Management Material. Tracking. Man-machine interfaces.

Process Operation Management Systems: Overview of process operation management systems, order, inventory management, process scheduling, quality management. Industrial Communication Systems: Characteristic features of industrial networks. Low level networks and their features, Field bus architecture. Performance aspects of Industrial Automation Systems.

Texts/References:

1. Webb J.W-Programmable controllers: Principle and Applications, PHI New Delhi
2. Parr A –Programmable Controllers: An Engineers' Guide ,Newnes, Butterworth-HeinnemanLtd-1993.
3. Liptak B.G (ED)-Process Control H and book, vol-2 Chilton book Co.
4. Noltinc- Handbook for Instrumentation Engineers.
5. Bollinger J.G and Duffie N.A-Computer control of machines and processes, Reading M A ,Addison-Wesley.,1988.

IN506 RESEARCH METHODOLOGY

Teaching Scheme: 01 L + 01T ; Total: 02 **Credits:** 02
Evaluation Scheme: 50 ICA **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This is a course on research attitude to provide students a thorough knowledge on the way towards research and its background. This course is suitable for first year PG and PhD students who are interested towards research in the field of science and technology and its applications. In this course, various methodology of work and analysis, its solution in engineering background will be studied.

COURSE OBJECTIVES:

The objectives of offering this course are to-
To learn the concept of research and to realize an engineering active and passive and dynamic research area. To understand the concept of way of research, to be able to represent a real research in engineering/social background and to solve the problem of society and familiarize with real time problems and its properties.. To initialize any research using any real facto-techniques including analysis and design, a real time problem would be best suited experienced example to start with. To understand the basic engineering and science design schemes, the concept of good fundamental and advanced topics in research are to be considered. This course gives short information of all the concepts which are required in initial phase of research.

COURSE OUTCOMES:

1. The students are exposed towards research attitude and motivation by meaning of defining research statement and hypothesis.
2. The researchers are identified from thoughts of construction of research problem and possible solution(s).
3. The students are able to become familiar with literature survey and research distinguishes.
4. The students are able to design sustainable research by means of data interpretation, compressive analysis and presentation.

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Develop research attitude and research statement	1, 3	Knowledge, Application
CO2	To construct research problem and solutions	1, 2	Analysis, Evaluation
CO3	Perform literature survey and result comparison	2, 3	Comprehension, Evaluation
CO4	Design research in the benefit of society(industry/social life etc)	2, 3	Synthesis, Creation

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1				1	1			3	1		2	2		1	
CO2		2			1		1	3	1		2	2		1	
CO3		1			1			2	1	2	2				2
CO4			2		1	2	2	2			2	3	3		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Research methodology: Problem definition and Understanding the language of research, Motivation and attitude towards research. Initialization and scope of the research.

Research problem statements and concepts, sustainable construction of the problem and solutions, operational definitions and possible best solutions, variables and factors involved during research work. Problem propositions and its impact.

Hypotheses, theories, and models - Research process, difficulties to start the research work. Research work versus need of research. Qualities in research work vs publications and presentations of research.

Literature review -Types of research- Problem identification and formulation, fundamental research, analysis based and advanced research. Literature reviews on practical solutions vs analytical solutions. Literature review of industrial solutions vs social solutions versus futuristic solutions to the industry or society.

Measurement issues - Methods of data collection, Types of data- Primary data- Scales of measurement- Sources and collection of data, Observation method. Hardware/software requirements in analysis and design.

Interview and presentation method, Survey experiments, primary and secondary data, data presentation, result presentation, abstract and conclusion presentation. Research design- Qualitative and Quantitative Research.

Text books:

1. Cooper, D. R. and Schindler, P. S., Business Research Methods, Tata McGraw Hill, 9th Edition. 2009.
2. Jackson, S.L., „Research Methods and Statistics", Cengage Learning India Private Limited, New Delhi, 2009.
3. Krishnaswamy, K.N., Sivakumar, A.I., and Mathirajan, M., Management Research Methodolog, Pearson Education , 2006.

Ref. books:

1. Lebrun, J-L.,Scientific Writing: A Reader and Writer"s Guide, World Scientific Publishing Co. Pte. Ltd., Singapore, 2007.
2. MLA, MLA Handbook for Writers of Research papers, Seventh Edition, Affiliated EastWest Press Pvt Ltd, New Delhi, 2009.
3. Thiel, D. V., Research Methods for Engineers, Cambridge University Press, 2014.

IN507 PG LAB - I

Teaching Scheme: 04 P ; Total: 04 **Credits:** 02
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:
This course is designed to provide practical knowledge thorough real time experiments for solving problems in control engineering. This course enhances the student's ability to analyze experimental data and develop empirical equations by verification of basic principles. It also helps to use computing device for process monitoring and control, data analysis, representation of empirical equations and their presentation.

DESIRABLE AWARENESS:
Knowledge of basic control systems and computer skills, modeling, and control strategies.

COURSE OBJECTIVES:
The objectives of offering this course are to-
The students will learn to conduct experiments to verify fundamental principles of control system engineering, calibrate measuring devices, interface process hardware with high end computing device through supporting software, analyze experimental data and develop empirical relations when appropriate.

COURSE OUTCOMES:
On the successful completion of this course, students will be able to -

1. To engage in independent study to identify the mathematical concepts, science concepts, engineering concepts and principles necessary to solve the identified control engineering problem
2. Ability to select the engineering tools/components for solving the identified control engineering problem
3. Analyze and interpret results of experiments conducted on the designed solution(s) to arrive at valid conclusions
4. Prepare effective written communication/ oral presentation on the real time experimentation conducted to solve engineering problem.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	To engage in independent study to identify the mathematical concepts, science concepts, engineering concepts and principles necessary to solve the identified control engineering problem	1,2	Remember, Understand
CO2	Ability to select the engineering tools/components for solvin identified control engineering problem	2,3	Understand, Apply
CO3	Analyze and interpret results of experiments conducted on the designed solution(s) to arrive at valid conclusions	2,3,4	Understand, Apply, Analyze
CO4	Prepare effective written communication/ oral presentation on the rea experimentation conducted to solve engineering problem.	3,4,5	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	2	-	1		1	-	1	1	-	-	-	1	1	-
CO2	-	1	-	1	2	-	-	1	1	-	1	-	2	2	1
CO3	1	2	2	3	1	-	-	1	1	-	-	-	1	2	-
CO4	-	-	-	1	2	-	-	1	1	1	1	1	-	2	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

A minimum of twelve experiments should be performed under PG Lab – I. Out of which minimum two experiments per course should be related to theory courses of that semester. A list of experiments that may be performed under various subjects of semester - I is given below. The list given below is just a guideline.

1. IN501 Modern Control Theory

Write a program to convert state space represented system (A, B, C, D) into transfer function (consider any simulation or practical system)

1. Obtain state space of the system from transfer function
2. Obtain state transition matrix for the any second order system (use any software)
3. Write a program/simulink to obtain time domain performance of DC motor
4. Check the controllability and observability of the system (program based)
5. Any example on observer design/pole placement
6. Write a program to design a simple controller based on given time domain specification.

2. IN502 Nonlinear Dynamic Systems

1. Simulate the various nonlinearities using Op. Amps.
2. Construct Phase Plane Trajectory by any method and compare it with MATLAB Simulation for a nonlinear system.
3. Write a MATLAB program to determine the stability of nonlinear systems using Lyapunov function.
4. Construct trajectories of Vander Pol's equation. (Analog Circuit Simulation)

3. IN503 Electrical Drives and Control

1. Speed and position control of DC servo motor by using traditional PI controller
2. Simulation for speed control of single phase induction motor based sensorless technique
3. Simulation of DC-DC Converter and three phase converter
4. Speed control of permanent magnet synchronous motor using FPGA spartan 6 controller

4. IN504A Process Instrumentation

1. To study the operation of a Level transmitter, I/P converter and control valve.
2. To determine step response of the 2nd order system and calculate time domain specifications.
3. To study PI, PID controller for single loop feedback level control system.
4. To study the closed loop cascade level sensor/transmitter from supervisory station i.e. from computer.

5. IN504C Soft Computing Techniques

1. Write a MATLAB program for learning rules and activation functions in neural network
2. Development of error back propagation algorithm for control application.
3. Design of a fuzzy controller systems using Fuzzy Logic Toolbox
4. Implementation of simple genetic algorithm for optimization of PID control parameters
5. Develop simulation model of adaptive neuro-fuzzy inference system (ANFIS) architecture for control application

6. IN505A Computer Aided Power System Analyasis

1. Modeling of power system components such as Alternators, Transformers, and Transmission lines.
2. Formation of Y bus and Z Bus matrices for given networks.
3. Representation of Sequence Networks.
4. Programming of power flow using Newton-Raphson Method.
5. Programming of power flow using Gauss Seidel Method.
6. Programming of power flow using Fast Decoupled Method.
7. Representation of Two port Networks in Z, Y, H type.
8. Study of effect of Faults (LG, LL, LLG, 3 phase) on a single machine connected to infinite Bus.

7. IN505B Transducer Technology

1. Design of electromechanical measurement system for strain/force measurement
2. Design proximity sensor (inductive, optical) for object detection
3. Design of electromechanical measurement system for liquid measurement system
4. Design of electromechanical measurement system for flow measurement system

8. IN505C Industrial Automation and Control

1 Develop ladder logic programs for different sequence control applications.
2 Develop one application on Man-Machine Interface
3 Develop logic on DCS to interface any system
4 Develop logic for multi-loop controller
5 Develop one application on inventory management from the systems available in laboratory
6 Develop one application on process scheduling from the systems available in laboratory

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester II of M. Tech. (Electrical Instrumentation and Control Engineering) with effect from academic year 2019-20

Course Code	Name of the Course	Group	Teaching Scheme*				Evaluation Scheme						Credit
							Theory			Practical		Total	
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN551	Modeling and Identification of Dynamic Systems	PC	3	…	…	3	30	10	60	…	…	100	3
IN552	Robotic Systems and Applications	PC	3	1	…	4	30	10	60	…	…	100	4
IN553	MOOCS Course (Approved by BOS)	PC	…	…	…	…	…	…	…	…	…	100	3
IN554	Professional Elective-III	PC	3	…	…	3	30	10	60	…	…	100	3
IN555	Professional Ethics	HM	3	…	…	3	30	10	60	…	…	100	3
IN556	PG Lab II	PC	…	…	4	4	…	…	…	25	25	50	2
IN557	Seminar	PC	…	…	2	2	…	…	…	50	…	50	2
Total			12	1	6	19	120	40	240	75	25	600	20

L : Lecture T: Tutorial P: Practical MSE: Mid Semester Examination
ISA :Internal Sessional Assessment ESE: End Semester Examination ICA : Internal Contineous Accessment

Professional Elective-III
IN554A Instrumentation System Design
IN554B Digital Control Systems
IN554C Adaptive & Robust Control Systems
IN554D Sliding Mode Control and Application

IN551 MODELING AND IDENTIFICATION OF DYNAMICAL SYSTEMS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The objective of this course is to expose students to different system identification concepts. Completion of this course develops the competency to formulate mathematical modeling of the real-time system through data-driven tools.

COURSE OBJECTIVES:

1. The concepts required for the development of mathematical models for industrial systems
2. Development of models from first principles.
3. Development of data-driven models.

DESIRABLE AWARENESS/SKILLS:

Model of different processes, Estimation algorithm for implementation, Identification tools.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	To explain dynamics systems with different examples	1,2	Knowledge,Comprehension
CO2	Apply different mathematical tools of model identification	2,3	Comprehension, evaluation
CO3	Develop a mathematical model for electrical and mech systems	1,4	Knowkedge,Analysis
CO4	Use of frequency response techniques and simulation softw develop model of physical system	4	Application
CO5	Derive model from input and output data using statistical t	3,5	Application,Synthesis

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	1	-	-	-	-	-	-	1	2	-
CO2	2	3	2	1	2	1	-	-	-	-	-	-	3	1	-
CO3	3	2	2	1	3	1	-	-	-	-	-	-	2	2	1
CO4	2	2	1	1	1	-	-	-	-	-	-	-	2	2	1
CO5	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Dynamic systems: Definitions related to dynamic systems, Examples of dynamic systems, Classification of system inputs, system models, System modeling and simulation. Models of Dynamical Systems: continuous and discrete models, equivalence of continuous and discrete-time models for different classes of input signals, input/output and state-space models.

Modeling of Mechanical and Electrical Systems:

Principles of modeling and simulation, fundamentals of theoretical modeling, classification of process elements, fundamental equations, energy Balance equations (mechanical, thermal, fluid, and electrical), Node and Mesh Equations, Analogies, Fundamental equations of mechanical dynamics(Newton's Laws of Kinetics, Principles of Mechanics), mechanical elements(Bars; Springs; Dampers; One-mass Oscillator), electrical drives(RLC Circuits; Direct Current Motors)

Introduction to system identification:
Identification based on differential equations, Laplace transforms frequency responses, difference equations, Signals and system concepts, auto-correlation, cross-correlation, power spectra. Random and deterministic signals for system identification: pulse, step, pseudo-random binary sequence (PRBS).
Nonparametric and parametric model estimation: Correlation and spectral analysis for non-parametric model identification, obtaining estimates of the plant impulse, step and frequency responses from identification data, parametric estimation using one-step ahead prediction error model structures and estimation techniques for ARX, ARMAX, nonlinear black-box models - Volterra, NARX, NARMAX, Wiener, Hammerstein.

Closed-Loop Identification: nonparametric closed-loop identification via correlation and spectral analysis, Identification with closed-loop data using indirect and direct approaches, Introduction to relay based identification.

Texts/References:

1. System Dynamics: Modeling Analysis, Simulation, Design by Ernest O. Dobling, Marcel Dekker Inc., 01st edition, 1996.
2. Desai and Lalwani, Identification Techniques, Tata McGraw Hill, 1977
3. Nelles, O. Nonlinear System Identification, Springer-Verlag, Berlin, 2001, ISBN: 3-54067369-5.
4. Karel J. Keesman, "System Identification, an introduction", Springer, 2011. Ljung, L. System Identification: Theory for the User, 2nd Edition, Prentice-Hall, 1999, ISBN 0-13- 656695-2.
5. Modeling and Simulation of Dynamic Systems by Robert Woods, Kent L. Lawrence, Prentice Hall, 5th Edition, 2005.

IN552 ROBOTIC SYSTEMS AND APPLICATIONS

Teaching Scheme: 03L+ 01 T; Total: 04 **Credits:** 04
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The study of robotics concerns itself with the desire to synthesize some aspects of human function by the use of mechanisms, sensors, actuators, and computers. This course is designed to provide students a thorough knowledge on the science and engineering of mechanical manipulation and suggests the control technique for working of robotic manipulators. This course is suitable for first year PG students who are interested to work/research in the field of robotics, control theory, automation and its applications. In this course, various methodology of modelling of robotics, kinematics and dynamics will be studied. Further, concepts of controller design and application will also be discussed. The theory is supported by numerical examples, practical examples and Matlab programming.

DESIRABLE AWARENESS:

Knowledge of basic control systems components, mathematics and computer skills, modeling, and control strategies.

COURSE OBJECTIVES:

Course Learning Objectives

1. To introduce the basic concepts, parts of robots and types of robots
2. To educate on various path planning and tracking techniques.
3. To discuss about the various applications of robots
4. To acquire knowledge of robotic control techniques.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Acquire knowledge of robotics fundamentals obtain the abil apply the same to engineering problems in a global perspective	1,2	Remember, Understand
CO2	Understand Concepts of mathematical modeling of robots and them.	2,3	Understand, apply
CO3	Exercise kinematics and dynamics of manipulators.	2,3,4	Understand, apply, analyze
CO4	Design the controller for robotic manipulator.	2,3	Understand, apply,
CO5	Select, Apply the robotic manipulator system for sp application.	3,4,5	apply, analyze, evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	1	-	-	-	-	-	-	-	3

CO2	2	2	1	-	1	-	-	-	-	-	1	2	2	1	2
CO3	-	2		1	1	-	-	-	-	-	-	-	1	-	-
CO4	1	2	3	2	3	1	-	-	-	-	2	2	2	1	1
CO5	1	3	2	-	2	2	2	1	2	2	3	3	2	1	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction: - Basic Concepts such as Definition degrees of freedom, Structure, Classification and Specifications of Robots, Industrial Robots. – Different types of robots. Manipulators, Drives, Sensors, End Effectors, Robotic system components- Notations- Position definitions.

Modeling of Robots: Coordinate Frames, Link description and connections, Manipulator kinematics, Mapping and Transformation; Direct Kinematic Model; Inverse Kinematics; Manipulator Differential Motion; Static Analysis; Jacobian, velocities and static forces.

Manipulator Dynamics: Acceleration of a rigid body, mass distribution, Newtons equation, iterative Newton - Euler dynamic formulation, Lagrangian formulation of manipulator dynamics, Inclusion of nonrigid body effects, Trajectory Planning, description and generation.

Linear and Non Linear Control of Manipulators: feedback and closed-loop control, control law partitioning, trajectory following control, multiinput multi output control systems, Cartesian based control scheme. current industrial-robot control systems, Force Control of manipulators: hybrid position/force control

Robot Programming, Robot Programming for Manufacturing and Other Applications, Robotic vision systems, image representation, object recognition and categorization, Robots in welding, Spray painting, assembly operation, cleaning, robot for underwater applications, design of multiple degrees of freedom, active and passive grippers -Factors influencing the choice of a robot, robot performance testing- Impact of robot on industry and society. New Trends & recent updates in robotics and Future scope.

Text Books:

1. Introduction to Robotics (Mechanics and Control), John J. Craig, Addison-Wesley, 2nd Edition,2004
2. Robotics: Control, Sensing, Vision and Intelligence, K.S. Fu, R.C. Gonzales, C.S.G. Lee, McGraw Hill, 1987.
3. Robotics and Control, Mittal R. K. and Nagrath I. J., Tata McGraw Hill, New Delhi , 2003
4. Industrial Robotics: Technology, Programming and Applications, Mikell P. Groover et. al. McGraw – Hill International, 1986.
5. Handbook of Industrial Robotics ,Shimon Y. Nof, John Wiley Co, 2001.

Reference Books:

1. Robotic Engineering: An Integrated Approach, Richard D. Klafter, Thomas A. Chemielewski, Michael Negin,Prentice Hall India, 2002
2. Introduction To Robotics, S. K. SAHA, Tata McGraw-Hill Education, 2008

IN553 MOOC COURSE

Teaching Scheme: 00L+ 00 T; Total: 00 **Credits:** 03
Evaluation Scheme: 100 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Massive Open Online Courses (MOOCs) are online courses available for anyone to enroll with a view to providing access to the best quality learning resources across the country, the project 'Study Webs of Active Learning for Young Aspiring Minds' (SWAYAM) has been started by Ministry of Human Resource Development, Department of Higher Education, Government of India. SWAYAM provides an integrated platform and portal for online courses, using information and communication technology (ICT) and covering High School till all higher education subjects and skill sector courses to ensure that every student, benefits from learning material through ICT. An initiative under National Mission on Education through Information Communication Technology (NME-ICT) Programme, NPTEL developed e-content for many Courses of various Disciplines.

Students can opt for any one MOOC course from the list of courses approved by Departmental Faculty Board/Board of Studies

IN554A INSTRUMENTATION SYSTEM DESIGN
PROFESSIONAL ELECTIVE-III

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course provides details of Instrumentation system design for measurement of different parameters such as pressure, temperature, flow, level etc. and Testing of transducer.

COURSE OBJECTIVES:

1. To understand the signal conditioning of different transducers.
2. To understand the design of control panels.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Design of temperature, flow, pressure, level etc transducers	1	Analyze
CO2	Design of control panels	2	Understand
CO3	Testing, Erection, Commissioning of typical process industry	3	Evaluate
CO4	Identify the various methods of signal transmission	4	Analyze
CO5	Appreciate the operation of typical instrumentation systems	5	Apply

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	2	2	-	-	-	-	2	3	3	-
CO2	3	2	1	1	2	2	2	-	-	-	-	2	3	2	-
CO3	2	3	2	2	2	2	1	-	-	-	-	2	2	2	-
CO4	3	3	2	2	2	2	2	-	-	-	-	2	2	2	-
CO5	3	1	3	1	3	1	1	-	-	-	-	2	3	3	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction: Introduction of Instrumentation System Design (ISD), Scope of ISD in Process Industry.
General transducer Design: Selection of Transducer, General procedure for Testing of transducer.
Design of RTD, T/C, Thermister based Temperature Instrumentation
Design of Pressure Gauge, Bellows, Bourdon Tube, and Diaphragm based Pressure Instrumentation.
Design of Orifice, Rotameter, Venturi meter flow Instrumentation
Design of different other sensing element: Resistive sensing element (eg. Potentiometer), Capacitive sensing element (eg. Variable Separation, area and dielectric), Inductive sensing elements (eg. Variable Reluctance), Electromagnetic sensing element (e.g. Velocity Sensors) , Level Instrumentation Design.
Design of Signal Conditioning elements: Deflection Bridges, Amplifiers, AC. Carriers systems, Current Transmitters, Oscillation and Resonation.
Design of Control Panels: Design of Control Room layout, Flameproof design, testing.
Comparison of system: Comparison of Pneumatic, Hydraulic and Electrical/Electronic Instrumentation systems and their selection for present process industry requirement.
Project Documentation: Specification Sheet, Index Sheet, Flow Diagram, Schedules used in typical process industry erection.
Testing, Erection, Commissioning: Testing, Erection, Commissioning of typical process industry

Reference Books

1. B. G. Liptak, Instrument Engineers Handbook, Vol. I and II, Third Edition, Chilton and Book Company, 1990.
2. D. M. Considine, Process/Industrial Instruments and Control Handbook, Fourth Edition, McGrawHill Inc., 1993.
3. C. D. Johnson, Process Control Instrumentation Technology, Fourth Edition, PHI, 1996.
4. Andrew and Williams, Applied Instrumentation in Process Industries, Vol. I, II, III, IV, Gulf Publishing Company, 1979.
7. John P. Bentley, Principles of Measurement Systems, Addison-Wesley publication, 1999.
8. T. R. Padmanabhan, Industrial Instrumentation: Principles and Design, Springer-Verlag Publications, 1999.
9. B. C. Nakra and K. K. Choudhari, Instrumentation: Measurement and Analysis, Tata McGraw Hill Pub, 1985.

IN554B DIGITAL CONTROL SYSTEMS
PROFESSIONAL ELECTIVE-III

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course provides knowledge about analysis of digital control systems for conventional and modern control systems.

COURSE OUTCOMES:

At the end of the course, students will demonstrate the able to

1. Obtain discrete representation of LTI systems
2. Analyze stability of open loop and closed loop discrete system
3. Design and analyze Discrete Controller
4. Design state feedback controller and estimators.

Course outcomes:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Obtain discrete representation of LTI systems	02	Understanding
CO2	Analyze stability of open loop and closed loop discrete system	04	Analyze
CO3	Design and analyze Discrete Controller	05	Evaluate
CO4	Design state feedback controller and estimators.	05	Evaluate

Relevance of POs and Strength of Correlation:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2														
CO2		2		1											
CO3			2												
CO4				2											

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Digital Control systems: Data conversion and quantisation - Sampling process- Mathematical modeling- Data reconstruction and filtering of sampled signals- Hold devices- z transform and inverse z transform - Relationship between s plane and z- plane- Difference equation - Solution by recursion and z-transform- Discretisation Methods.

Analysis of Digital Control Systems: Digital control systems- Pulse transfer function - z transform analysis of closed loop and open loop systems- Modified z- transfer function- Multirate z-transform - Stability of linear digital control systems - Stability tests- Steady state error analysis- Root loci - Frequency domain analysis- Bode plots- Nyquist plot s- Gain margin and phase margin.

Classical Design of Digital Control Systems: (Cascade and feedback compensation by continuous data controllers- Digital controllers-Design using bilinear transformation- Root locus based design- Digital PID controllers- Dead beat control design – Case study examples using MATLAB

Advanced Design of Digital Control Systems: State variable models- Interrelations between z- transform models and state variable models - Controllability and Observability - Response between sampling instants using state variable approach - Pole placement using state feedback – Servo Design- State feedback with Integral Control-Deadbeat Control by state feedback and deadbeat observers- Dynamic output feedback- Effects of finite word length on controllability and closed loop pole placement- Case study examples using MATLAB.

Ref. books:

1. Digital Control Systems B. C Kuo , second Edition, Oxford University Press, Inc., New York, 1992.
2. Digital control of Dynamic Systems, G. F. Franklin, J.D. Powell, and M.L. Workman Addison Wesley Longman, Inc., Menlo Park, CA, 1998.
3. Digital Control and State Variable Methods, M. Gopal, Tata McGraw Hill Publishing Company, Third Edition, 2009.
4. Microcomputer architecture and Programs, John F. Walkerly, John Wiley and Sons Inc., New York, 1981.
5. Discrete Time Control Systems, K. Ogata, Addison-Wesley Longman Pte. Ltd., Indian Branch, Delhi, 1995.
6. Digital Control Systems, C. H. Houpis and G.B. Lamont, McGraw Hill Book Company, 1985.
7. Digital Control System Analysis and Design, C. L. Philips and H.T NagleJr., Prentice Hall, Inc., Englewood Cliffs, N.J., 1984.

IN554C ADAPTIVE AND ROBUST CONTROL SYSTEMS
PROFESSIONAL ELECTIVE-III

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION/COURSE OBJECTIVE:

In this course students will study and able to

1. Explain the adaptive control system, essential aspect of adaptive control system and its classification.
2. Evaluate performance of Stochastic and Predictive Self tuning regulators
3. Demonstrate different configurations, classification, Mathematical description of MRAS system with design
4. Demonstrate the modelling and design of robust control system
5. Explain the advantages and disadvantages of robust control relative to other control approaches.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the adaptive control system, essential aspect of adaptive control system and its classification.	1	Analyze
CO2	Evaluate performance of Stochastic and Predictive Self tuning regulators	2	Understand
CO3	Demonstrate different configurations, classification, Mathematical description of MRAS system with design	3	Evaluate
CO4	Demonstrate the modelling and design of robust control system	4	Analyze
CO5	Explain the advantages and disadvantages of robust control relative to other control approaches.	5	Apply

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	1	-	-	-	3	-
CO2	1	-	-	-	3	-	-	2	-	2	-	-	3	2	-
CO3	2	-	3	-	2	2	1	2	-	2	2	-	3	2	1
CO4	-	2	3	3	3	-	-	2	-	2	2	1	3	2	1
CO5	2	-	-	-	-	-	-	-	-	-	-	-	1	3	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

ADAPTIVE CONTROL

Introduction: Definitions, History of adaptive Control, Essential aspects of adaptive control, Classification of adaptive control system: Feedback adaptive controllers, Feed forward adaptive controllers, Why adaptive control? Parametric models of dynamical systems

Real time parameter estimation: Least squares and regression models, Estimating parameters in Dynamical Systems, Experimental conditions, Prior information, MLE, RLS,Instrument variable method.

Deterministic Self tuning regulators (STR): Pole placement design, Indirect self tuning regulators, Continuous time self tuners, Direct self tuning regulators, disturbances with known characteristics.

Stochastic and Predictive Self tuning regulators: Design of Minimum variance and Moving average controllers, Stochastic self tuning regulators, Unification of direct self tuning regulators. Linear quadratic STR, adaptive predictive control.

Model reference adaptive control (MRAS): Model Reference Adaptive System: Different configuration of model reference adaptive systems; classification of MRAS, Mathematical description, Equivalent representation as a nonlinear time-varying system, direct and indirect MRAS. MIT rule,Design of MRAS using Lyapunov theory, Relations between MRAS and STR

ROBUST CONTROL

Basics: Control system representations, System stabilities, Coprime factorization and stabilizing controllers, Signals and system norms

Modelling of uncertain systems: Unstructured Uncertainties, Parametric uncertainty, Linear fractional transformation, Structured uncertainties.

Robust design specifications: Small gain theorem and robust stabilization, Performance considerations, structured singular values.

Design: Mixed sensitivity optimization, 2-Degree of freedom design, Sub-optimal solutions, Formulae for discrete time cases.

Design case studies: case studies like Robust Control of a mass damper spring system, A triple inverted pendulum control system, Robust control of a hard disk drive

Texts books /References

1. K.J. Astrom and B. Wittenmark, Adaptive Control, 2nd ed., Pearson Education, 1995.
2. Petros Ioannou and Baris Fidan, Adaptive Control Tutorial, SIAM, 2006.
3. P.A. Ioannou and J. Sun, Robust Adaptive Control, Prentice Hall, 1995.
4. Sankar Sastry and Marc Bodson, Adaptive Control- Stability, Convergence and Robustness, Springer, 2011.
5. D.-W.Gu, P.Hr.Petkov and M.M.Konstantinov, Robust Control Design with MATLAB, Springer, 2005. 6 Alok Sinha, Linear Systems- Optimal and Robust Controls, CRC Press, 2007.
6. G.E. Dullerud, F. Paganini, A course in Robust control theory- A convex approach, Springer, 2000.
7. Kemin Zhou, John Comstock Doyle, Essentials of robust control, Prentice Hall, 1998

IN554D SLIDING MODE CONTROL AND APPLICATION
PROFESSIONAL ELECTIVE-III

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This is a course on sliding mode control and its applications, is of unique nature in the modern engineering field. This course is designed to provide students a thorough knowledge on sliding technique with concepts of robust control and its background. This course is suitable for first year PG students who are interested to work/research in the field of aerospace, automation, control, instrumentation, electrical, multidisciplinary field of engineering and technology, and its applications. In this course, various methods of sliding mode controllers (SMCs) in transfer function or state space will be studied. Further, best possible control and stability analysis issues will be discussed. The concepts of SMC are supported by numerical examples, practical examples and/or Matlab/Scilab programming.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. Understand the advanced technique in control
2. To apply knowledge to design best suited controller
3. Concepts of sliding surface, continuous and discrete control law
4. Implementation of SMCr for numerical/practical examples

COURSE OUTCOMES:

1. The students are exposed towards concepts of advanced controller.
2. The students shall be able to thoughts of construction of sliding surfaces for given system.
3. The students can become familiar with continuous and discrete control laws.
4. The students can design and implement sliding mode control techniques for system.

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	To formulate advanced control concept of controller	1, 2	Knowledge, Comprehension.
CO2	To construct sliding surface and find equivalent controller	1, 2	Analysis, Evaluation
CO3	Understand and implement continuous and discrete control laws	3, 2	Application, Evaluation
CO4	Design sliding mode controllers for systems	3, 1	Creation, Synthesis

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2				1									1	
CO2		2		1	1									2	
CO3		2		1	1					1					1
CO4			3		1	1	1		1			1	2		2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction: Variable Structure Systems (VSS), Introduction, Synthesis of stable systems from unstable structures, VSS for improving speed of response,VSS for stability, concepts of sliding surface, continuous sliding mode control and discrete sliding mode control. Concepts of total law,

Sliding mode control basics: Variable structure systems with sliding mode- sliding mode motion- existence condition- equivalent control for sliding mode motion- sliding mode motion on switching line- Invariance conditions- Design of sliding mode controllers using feedback linearisation for non-linear systems- simulation of sliding mode controller using simulink., design of stable switching surfaces- design of sliding mode controller for simple systems, Chattering phenomenon and Chattering reduction techniques.

Simulation of systems-I: Definition of sliding surface, equivalent law and its importance. Some case studies on simulation of various switching functions, the analysis and theoretical background of the discrete part of SMC. Applications and results using any software.

Simulation of systems-II: To obtain moded of any real system, its behavior and real time differentiation and comparison. Some of the case studies of simulation of first order systems, case studies and simulation of second order systems. Concepts of higher order systems and its reduction using step response only.

Applications-I: Design of simple SMC for systems, First order systems, error calculation, the system parameters, uncertain parameters of the system, study of other controllers in the literature, analysis and observability. Case study for programming/simulation (first/second order example)

Application-II: Modeling of typical first order systems, its theoretical analysis, comparative studies of controllers, sliding control mode for typical systems.simulation and results. Research work implementation and its analysis and simulation. Practical situation and its engineering application. Case study for programming/simulation (first/second order example)

Text books:

1. Eduardo A. Misawa (Editor), Leonid M. Fridman (Editor), Fundamentals of Sliding Mode Control Wiley-Blackwell publications, 2003
2. Vadim Utkin, Juergen Guldner, Jingxin Shi, Sliding Mode Control in Electro-Mechanical Systems, CRC press, Second edition, 2019.
3. Jinkun Liu, Sliding Mode Control Using MATLAB 1st Edition, Academic press, 2017.

Ref. books

1. B. Bandyopadhyay, D. Fulwani, K.-s. Kim, "Sliding Mode Control Using Novel Sliding Surfaces", Lecture Notes in Control and Information Sciences, Springer-Verlag, ISBN 978-3-642-03447-3., Oct., 2009.
2. B. Bandyopadhyay, S. Janardhanan, S. K. Spurgeon, "Advances in Sliding Mode Control: Concept, Theory and Implementation", Lecture Notes in Control and Information Sciences, Springer-Verlag, ISBN 978-3-642-36985-8 , , 2013.
3. Leonid Fridman, Jean-Pierre Barbot, Franck Plestan, Recent Trends in Sliding Mode Control, The Institution of Engineering and Technology, 2016
4. C Edwards and S Spurgeon, Sliding Mode Control: Theory and Applications" CRC press, 1998.

IN555 PROFESSIONAL ETHICS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Technology has pervasive and profound effect on the contemporary world, and engineers play a central role in all aspects of technological development. In order to hold paramount, the safety, health and welfare of the public, engineers must be morally committed and equipped to grapple with ethical dilemmas they confront.

Ethics in Engineering provides an introduction to the issues in engineering ethics. It places those issues within a philosophical framework, and it seeks to exhibit their social importance and intellectual challenge. The goal is to stimulate reasoning and to provide the conceptual tools necessary for responsible

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
2. provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
3. To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights.
4. To have an adequate knowledge about MNC's, Business, Environmental, Computer Ethics, Honesty, Moral Leadership, sample Code of Conduct.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	List, classify and express the importance of Values and Ethics in their Personal lives and professional careers	1,2	Knowledge, Comprehension
CO2	Illustrate and analyse the rights and responsibilities	3,4	Applications, Analysisi
CO3	Categorize and explore Responsibilities of employee, team member and a global citizen	4	Analysis
CO4	Explore and investigate the basic perception of profession, professional ethics, various moral & social issues, industrial standards, code of ethics and role of professional ethics in engineering field	5	Synthesis

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	3	-	1	-	-	-	3	-
CO2	1	-	-	-	3	-	-	3	-	2	-	-	3	2	-

CO3	2	-	3	-	2	2	1	3	-	2	2	-	3	2	1
CO4	-	2	3	3	3	-	-	3	-	2	2	1	3	2	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Meaning and Nature of Ethics, Moral and Ethics: Importance of Ethics, Types of Ethics, Causes of Unethical Behavior

Meaning, Nature and Importance of Business Ethics, Types of Business Ethics, Factors Influencing Business Ethics, Corporate Ethics: Ethical Behavior and Audit of Ethical Behavior,

Individual Ethics, Professional Ethics, Gandhian Philosophy of Ethical Behavior, Social Audit, Concept of Globalization and Global Business Network, Relationship among Business,

Business Ethics and Business Development Developing Business System Ethics relating to Ethics in Global Economy, Marketing Ethics in Foreign Trade, Role of Business Ethics in Developing Civilized Society, Concept of Corporate Social Responsibility Relationship between CSR and Business Ethics, Justice and Economic

Environment Protection, Business Ethics and Consumer Protection, Business Ethics and Social Justice Arguments for and against Corporate Social Responsibility, Meaning of Functional Ethics,

Types of Ethics according to Functions of Business (Marketing and HRM), Types of Ethics according to Functions of Business (Purchase, Selling and Distribution)

Patents, Copy-rights, Intellectual Property rights, Trade Marks, and Business Ethics, Ethical Value System, Values, Indian Values and Ethics, Business Ethics, Ethics and Corporate Excellence, Indian and Global Case Studies

Text books:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

Ref. books

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

IN556 PG LAB II

Teaching Scheme: 04 P ; Total: 04 **Credits:** 02
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:
This course is designed to provide practical knowledge thorough real time experiments for solving problems in control engineering. This course enhances the student's ability to analyze experimental data and develop empirical equations by verification of basic principles. It also helps to use computing device for process monitoring and control, data analysis, representation of empirical equations and their presentation.

DESIRABLE AWARENESS:
Knowledge of basic control systems and computer skills, modeling, and control strategies.

COURSE OBJECTIVES:
The objectives of offering this course are to-
The students will learn to conduct experiments to verify fundamental principles of control system engineering, calibrate measuring devices, interface process hardware with high end computing device through supporting software, analyze experimental data and develop empirical relations when appropriate.

COURSE OUTCOMES:
On the successful completion of this course, students will be able to -

1. To engage in independent study to identify the mathematical concepts, science concepts, engineering concepts and principles necessary to solve the identified control engineering problem
2. Ability to select the engineering tools/components for solving the identified control engineering problem
3. Analyze and interpret results of experiments conducted on the designed solution(s) to arrive at valid conclusions
4. Prepare effective written communication/ oral presentation on the real time experimentation conducted to solve engineering problem.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	To engage in independent study to identify the mathematical concepts, science concepts, engineering concepts and principles necessary to solve the identified control engineering problem	1,2	Remember, Understand
CO2	Ability to select the engineering tools/components for solvin identified control engineering problem	2,3	Understand, Apply
CO3	Analyze and interpret results of experiments conducted on the des solution(s) to arrive at valid conclusions	2,3,4	Understand, Apply, Analyze
CO4	Prepare effective written communication/ oral presentation on the rea experimentation conducted to solve engineering problem.	3,4,5	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	2	-	1		1	-	1	1	-	-	-	1	1	-
CO2	-	1	-	1	2	-	-	1	1	-	1	-	2	2	1
CO3	1	2	2	3	1	-	-	1	1	-	-	-	1	2	-
CO4	-	-	-	1	2	-	-	1	1	1	1	1	-	2	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

A minimum of twelve experiments should be performed under PG Lab – II. Out of which minimum two experiments per course should be related to theory courses of that semester. A list of experiments that may be performed under various subjects of semester - II is given below. The list given below is just a guideline.

1. IN551 Modelling and Identification of Dynamic Systems

1. Derive the model for translational and Rotational Systems
2. Estimating Transfer Function Models for a Heat Exchanger
3. System identification based on Step and Impulse response considering first and second order transfer function models
4. Modeling, identification, and simulation of the inverted pendulum
5. DC Motor Position System Modeling, Identification and simulation
6. Estimate Coefficients of ODEs to Fit Given Solution
7. Estimate parameters of ARMAX, ARIMAX, ARMA, or ARIMA model using time-domain data

Note: For simulation purpose Scilab or Matlab types of simulator software use for identification and simulation

2. IN552 Robotic Systems and Applications

Study components of an industrial robot (Puma, KUKA, FANUC, ETC) and its DH parameters.

1. Forward kinematics and validation using a software (RoboAnalyser)
2. Inverse kinematics of an industrial robot and validation using software (RoboAnalyser, Matlab)
3. Trajectory tracking problem analysis using Matlab simulations
4. experiments on laboratory setup as avaliable based on syllabus of Robotic system and applications.
5. design and analysis of controllers for robotic manipulators.

3. IN554A Instrumentation System Design

1. Design of Signal Conditioning elements for Thermocouple.RTD etc.
2. Design of Signal Conditioning elements for Level transducers ..
3. Design of Signal Conditioning elements for Pressure transducers.etc.
4. Design of Signal Conditioning elements for flow transducers. etc
5. Design of Control Panels for any process Instrumentation.
6. Testing and Commissioning of typical process industry equipments.

4. IN554B Digital Control Systems

Experiments to be designed based on contents covered in IN554B course

5. IN554C Adaptive and Robust Control Systems

Experiments to be designed based on contents covered in IN554C course

IN557 SEMINAR

Teaching Scheme: 00L+ 00 T; Total: 00 **Credits:** 02
Evaluation Scheme: 50 ICA **Total Marks:** 50
ESE Duration: 1 Hr

COURSE DESCRIPTION:

This course explores the knowledge of presentation and communication. Also, it develops ability to work on identify, formulate and solve engineering problems in view of economic, environmental and social aspect.

COURSE OBJECTIVES:

1. To develop the ability to express our views and improve presentation skills.
2. To study various international, national journals to identify, understand and formulate the problem.
3. To apply effective strategies in literature searches

COURSE OUTCOMES:

Upon successful completion of this course the students will be able to:

1. understand literature survey for selection of seminar topics.
2. apply knowledge of mathematics, science and engineering for effective presentation.
3. identify, formulate and solve engineering problems by understanding professional as well as ethical responsibility.

COURSE CONTENT

1. Each student shall select a topic for seminar which is not covered in curriculum. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis.
2. Topic of seminar shall be registered within three weeks from commencement of VII semester and shall be approved by the committee.
3. The three-member committee appointed by Head of Department shall be constituted for finalizing the topics of seminar. Seminar shall be related state of the art topic of his/her choice approved by the committee.
4. Each student should deliver a seminar in a scheduled period (Specified in time framed by the department) and submit the seminar report (spiral bound). Guidelines for ICA: Assessment of the seminar for award of ICA marks shall be done jointly by the guide and a departmental committee

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester III of M. Tech. (Electrical Instrumentation and Control Engineering) with effect from academic year 2019-20

Course Code	Name of the Course	Group	Teaching Scheme*				Evaluation Scheme					Total	Credit
							Theory			Practical			
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN601	Dissertition I	…	…	…	…*	…	…	…	…	100	50	150	7
IN602	Effective Technical Communication	HM	…	…	2	2	…	…	…	50	…	50	2
IN603	Intellectual Property Right	HM	1	1	…	…	…	…	…	50	…	50	2
Total			1	1	2	2	0	0	0	200	50	250	11

* Laboratory Work: 10 hours / week and Guide Contact: 4 Hours / Week

L : Lecture T: Tutorial P: Practical MSE: Mid Semester Examination
ISA :Internal Sessional Assessment ESE: End Semester Examination ICA : Internal Contineous Accessment

Note: 1. Group indicates curriculum component as defined earlier. PC- Professional/Programme Core

Scheme for Semester IV of M. Tech. (Electrical Instrumentation and Control Engineering) with effect from academic year 2019-20

Course Code	Name of the Course	Group	Teaching Scheme*				Evaluation Scheme					Total	Credit
							Theory			Practical			
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN651	Dissertation II	PC	…	…	…	…	…	…	…	100	200	300	15
Total			0	0	0	0	0	0	0	100	200	300	15

* Laboratory Work: 20 hours / week and Guide Contact: 10 Hours / Week

L : Lecture T: Tutorial P: Practical MSE: Mid Semester Examination
ISA :Internal Sessional Assessment ESE: End Semester Examination ICA : Internal Contineous Accessment

IN601 DISSERTITION I

Laboratory work: 10 hrs per week | **Credits:** 07
Guide Contact Hrs: 4 hrs | **Total Marks:** 150
Evaluation Scheme: 100 ICA + 50 ESE | **ESE Duration:** 3 Hrs

COURSE DESCRIPTION:

The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

In Dissertation – I, the student should present the progress report of the dissertation including problem statement, literature survey, project overview and scheme of implementation. Before the end of the semester, student shall submit one copy of progress report in the prescribed format, reporting the total work completed by him/her.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, and a record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress / performance of the student based on report, presentation and depth of understanding.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by guide throughout the semester and by a departmental committee before the end of the semester appointed by the Head of Department.
- Guide shall judge the student on the basis of regularity, work completed, presentation, effort taken by student, etc.
- The candidates shall give a presentation on the dissertation topic before a departmental committee along with demonstration of working model.
- The student shall be assessed on the basis of presentation/communication skill, depth of understanding, selection of dissertation topic, literature survey, work completed, result and dissertation - II report, etc.

End Semester Examination (ESE)

- The ESE shall be evaluated by a panel of two examiners viz. guide and external examiner.
- The candidates shall present the work on the dissertation topic before the examiners and shall be assessed on the basis of presentation/communication skill, depth of understanding, selection of dissertation topic, literature survey, work completed, result and dissertation - II report, etc.

IN602 EFFECTIVE TECHNICAL COMMUNICATION

Teaching Scheme: 02 P ; Total: 02 **Credits:** 02
Evaluation Scheme: 50 ICA **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The goal of this course is to prepare engineering students with the individual and collaborative technical writing, presentation, and research skills necessary to be effective technical communicators in academic and professional environments. This course meets the criteria for a communications intensive (CI) course.

DESIRABLE AWARENESS:

Knowledge of basic English grammar/language mechanics and computer skills.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. To reinforce the importance of effective business communication for success in today's business environment.
2. To enhance the communication skills required in different business contexts through various interactive activities.
3. To acquaint the students with the basic concepts and techniques of communication such as Listening, Speaking, Reading and Writing skills (LSRW skills) those are useful in developing skills of communicating effectively.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	State the characteristics of technical writing and the importance of purpose, audience, and genre for written communication in technical fields.	1,2	Knowledge, Comprehension
CO2	Express complex engineering ideas appropriate for targeted audiences.	2,3	Comprehension, Application.
CO3	Planning, drafting, revising, editing, and critiquing technical and professional documents through individual and collaborative writing.	3,5	Application, Synthesis
CO4	Researching, analyzing, synthesizing, and applying information to create technical reports.	1, 4	Knowledge, Analysis
CO5	Recognizing ethical implications of technical communication in professional contexts.	1,4	Knowledge, Analysis

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	1	2	-	-	2	-	-	2	2	3	2	2	-	-	2
CO2	2	2	1	-	2	-	-	2	2	3	2	2	1	-	2

CO3	1	2	1	-	2	-	-	2	3	3	3	1	1	-	3
CO4	1	3	2	-	2	-	-	3	3	1	2	1	1	1	3
CO5	1	2	-	-	2	-	-	2	2	3	2	2	-	-	2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content:

Effective Presentation Strategies, Define the purpose of presentation, Analyzing audience and locale, organizing contents, Preparing an Outline, Visual Aids, Understanding the nuance of delivery, sample speech and practice the presentation, Reading: Speed reading practice, Transcoding: verbal and non-verbal, Eye-reading practice, Analytical and critical reading practice.

Listening techniques, Types of listening, listening with a purpose, Barriers to listening: Physical and psychological, Steps to overcome them, Purposive listening practice, Active listening and anticipating the speaker, Successful telephone etiquette, listening comprehension, effective listening strategies, listening in conversational interaction, team listening

Speaking: Fluency and accuracy in speech, Positive thinking, Improving self expression, Listener oriented speaking, Group discussion practice, Developing persuasive speaking skills, Use of technology in oral communication, Speech techniques Conversation and oral skills, strategies for good conversation, techniques to develop effective word accent, word stress, primary and secondary stress, use of correct stress pattern, developing voice quality, developing correct tone.

Writing technical reports, research papers, dissertation, thesis and research proposals. Important parts of reports like abstract, results, conclusion. Supplementary parts like list of symbols, list of tables, annexures, references etc. Making title page, writing mathematical equations, including graphics, making tables and writing references using LaTex/ MiKTeX. Assignment for one technical proposal, one research paper and one technical report should be submitted using LaTex/MikTeX for in semester assessment.

Text books:

1. Technical Communication-principles and practice by Meenakshi Raman, Sangeeta Sharma, 1st Edition, Oxford university Press, 2002.
2. Effective Technical Communication, M Ashraf Rizvi, 1st Edition, Tata Mcgraw Hill, 2004.
3. Effective Technical Communication by Barun K. Mitra, 1st Edition, Oxford University Press, Delhi. 2006.

Reference Books:

1. Communication for Business by Shirley Taylor, Longman, New Delhi, 1999.
2. Best Science Writing: Readings and Insights by Robert Gannon, University Press, Hyderabad, 2000.
3. How to Increase Reading Ability by Albert J. Harris, Edward R.Sipay, Longman, 1990.
4. Latex: A document preparation system by Leslie Lamport, 2nd Edition, Addison Wesley, Massachusetts, 2001.

IN603 INTELLECTUAL PROPERTY RIGHT

Teaching Scheme: 01L+ 01 T; Total: 02 **Credits:** 02
2Evaluation Scheme: 50 ICA **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION / COURSE OBJECTIVES

Various types of Intellectual Property Rights Patentable Subject History of Indian Patent Protection, Patent filing procedure in India, Opposition- pre-grant opposition and post-grant opposition, Patent filing procedure under PCT, advantages, patent search and literature and Salient features of Indian Patents are discussed in detail.

COURSE OUTCOME

After completion of the course students will be able to

1. Explain the knowledge about the IPR categories and related activities
2. Use the knowledge of acts regarding patent, features of patents while filing the patent
3. Apply for the patent as per the procedure of filing patent
4. Differentiate between Indian US, European patent system

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1
CO2	-	-	-	-	1	-	1	1	-	-	-	-	-	-	2
CO3	-	-	-	-	2	2	3	3	1	2	-	3	-	-	3
CO4	-	-	-		1	-	-	-	-	-	-	-	-	-	1

Course Content:

Introduction

Intellectual property: meaning, nature and significance, need for intellectual property Right (IPR), IPR in India – Genesis and development ,Types of Intellectual Property Rights (Patents, Trademarks, Copyrights, Geographical Indications Industrial Designs and Trade secrets), Patentable Subject Matter (Novelty, NonObviousness, Utility, enablement and Best mode),

Patent Systems

History of Indian Patent Protection, Rationale behind Patent System, Objectives and Advantages of Patent System, and future challenges. Indian Patents Act 1970, Definitions and Key Terminology, Types of Patent applications, Inventions not patentable Patent filing procedure in India (Patent Prosecution), Specifications (Provisional and Complete), Claims- types of claims and legal importance of claims, Grant of patent, Rights of Patentee and co-owners Opposition- pre-grant opposition and post-grant opposition, Anticipation,

Infringement, Compulsory Licensing, revocation of patents, and power of Controller. Patent filing procedure under PCT, advantages, patent search and literature,

International treaties and acts of patent

Salient features of Indian Patents (Amendments) Act 1999, 2002 and 2005. US and European Patent System, Background, Salient Features and Impact of International Treaties / Conventions like\ World Trade Organization (WTO) ,World Intellectual Property Organization (WIPO) Patent Co-operation Treaty (PCT), Madrid Protocol

State Law

Trade Secret, Contract, Misappropriation, Right of Publicity Trademarks, Trade Secret - Overview, Requirements, Misappropriation of Trade Secret, Departing Employees, Remedies, Criminal Liability, Click wrap Agreements, Idea Submissions; Right of Publicity, Federal Preemption, Review.

Text Books:

1. W. R. Cornish and D. Llewellyn, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights, Sweet & Maxwell.
2. Lionel Bently and Brad Sherman, Intellectual Property Law, Oxford University Press.
3. P. Narayanan, Intellectual Property Law, Eastern Law House
4. B. L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing Co.
5. V. K. Ahuja, Law Relating to Intellectual Property Rights, LexisNexis.
6. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business
7. Implications;Macmillan India ltd, 2006
8. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.
9. Draft manual of Patent Practice and Procedure -2008 , The Patent Office, India
10. Manual of Patent Office Practice and Procedure -2010

Reference Books:

1. The Copyright Act, 1957
2. The Patent Act, 1970
3. The Trade Marks Act, 1999
5. The Designs Act, 2000
6. The Geographical Indication of Goods Act, 1999
7. The Protection of Plant Varieties and Farmers' Rights Act, 2001

IN651 DISSERTITION II

Laboratory work: 10 hrs per week | **Credits:** 07
Guide Contact Hrs: 4 hrs | **Total Marks:** 150
Evaluation Scheme: 100 ICA + 50 ESE | **ESE Duration:** 3 Hrs

COURSE DESCRIPTION:

The dissertation should be based on the knowledge acquired by the student during the course work and should contribute to the needs of the society. The dissertation aims to provide an opportunity of designing and building, complete system or subsystem in the domain area.

DESIRABLE AWARENESS/SKILLS

Knowledge of the domain of dissertation

COURSE OUTCOMES

On the successful completion of this course, student shall be able to

1. synthesize acquired knowledge and skills and apply to solve new technical problem.
2. select a suitable technique from different methodologies, and forms of analysis to produce a suitable research design.
3. present the experimental work done in a written report.
4. present / publish the work in international/ national conference and/or reputed journals.

Course Content:

Dissertation will consist of a system development in Software/ Hardware.In continuation with the work completed in semester III, student shall complete the implementation of ideas given in synopsis of dissertation, so that working model of dissertation shall be complete before the end of semester. Students shall submit final dissertation report in prescribed format which shall include the work completed in semester III also.

Dissertation report shall include -

(i) Literature review
(ii) Concepts, problem definition
(iii) Functional and technical details
(iv) Results and discussion, conclusions and contributions
(v) Comparison with contemporary techniques
(vi) Future scope
(vii) References

The candidate has to present / publish at least one paper in reputed national / international journal/ conference based on the dissertation work before submission of the dissertation report.

PHASE II DELIVERABLES:

Record of continuous progress, dissertation report as per the specified format, developed system in the form of hardware and/or software.

PHASE II EVALUATION

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by guide throughout the semester and by a departmental committee before the end of the semester appointed by the Head of Department.
- Guide shall judge the student on the basis of regularity, work completed, presentation, effort taken by student, etc.
- The candidates shall give a presentation on the dissertation topic before a departmental committee along with demonstration of working model.
- The student shall be assessed on the basis of presentation/communication skill, depth of understanding, selection of dissertation topic, literature survey, work completed, result and dissertation - II report, etc.

End Semester Examination (ESE)

- The ESE shall be evaluated by a panel of two examiners viz. guide and external examiner.
- The candidates shall present the work on the dissertation topic before the examiners and shall be assessed on the basis of presentation/communication skill, depth of understanding, selection of dissertation topic, literature survey, work completed, result and dissertation - II report, etc.