COURSES OF STUDY (Syllabus)
M. Tech. (Instrumentation Engineering)
(Effective from Academic Year 2018-19)

Department of Instrumentation Engineering,
SGGS Institute of Engineering and Technology, Vishnupuri, Nanded-431606 (MS), India
(An autonomous institute established by Govt. of Maharashtra)

M. Tech. Syllabus (Based on AICTE Model):

Semester I							
Sr. No.	**Course Type**	**Course**	**Course Name**		**Teaching Scheme**		**Credits**
					L	T	P	
1.	Professional Core Course I	PCC-IN501	Process Instrumentation		3	0	2	4
2.	Professional Core Course II	PCC-IN502	Advanced Digital signal Processing		3	0	2	4
3.	Professional Core Course III	PCC-IN503	Modern Control Theory		3	0	2	4
4.	Professional Elective Course I	PEC-IN504	PEC-IN504-1	Biomedical Instrumentation	3	0	2	4
			PEC-IN504-2	Adaptive Control System				
			PEC-IN504-3	Computational Methods of Optimization				
			PEC-IN504-4	Process Modeling & Optimization				
5.	Professional Elective Course II	PEC-IN505	PEC-IN505-1	Artificial Intelligence in Control	3	0	0	3
			PEC-IN505-2	Optimal and Robust Control				
			PEC-IN505-3	Probability, Statistics and Stochastic Processes				
			PEC-IN505-4	Internet of Things				
6.	Mandatory Credit Course	MCC-590	Research Methodology and IPR		2	0	0	2
7.	Mandatory Audit Course	MAC-591	English for Research Paper Writing.		2	0	0	0
				Total	**19**	**0**	**8**	**21**

Semester II								
Sr. No.	**Course Type**		**Course Name**		**Teaching Scheme**			**Credits**
					L	T	P	
1.	Professional Core Course IV	PCC-IN510	Instrumentation System Design		3	0	2	4
2.	Professional Core Course V	PCC-IN511	Computer Process Control		3	0	2	4
3.	Professional Elective Course III	PEC-IN512	PEC-IN512-1	Industrial Automation	3	0	2	4
			PEC-IN512-2	Estimation and Identification				
			PEC-IN512-3	Advanced Power Electronics				
			PEC-IN512-4	Robotics				
4.	Professional Elective Course IV	PEC-IN513	PEC-IN513-1	Digital Image Processing	3	0	2	4
			PEC-IN513-2	Applied Nonlinear Control				
			PEC-IN513-3	Industrial Communication Systems				
			PEC-IN513-4	Wireless Instrumentation & Safety				
5.	Open Elective	OEC-IN514	From the list given below.		3	0	0	3
6.	Mini Project	PROJ-IN515	Mini Project and Seminar		0	0	4	2
7.	Audit course II	AUD-9**	From the list given below.		2	0	0	0
				Total	**17**	**0**	**12**	**21**

Semester III							
Sr. No.	**Course Type**	**Course Code**	**Course Name**	**Teaching Scheme**			**Credits**
				L	T	P	
1	Dissertation	DIS-IN-601	Dissertation – I	0	0	28	14
			Total	**0**	**0**	**28**	**14**

Semester IV							
Sr. No.	**Course Type**	**Course Code**	**Course Name**	**Teaching Scheme**			**Credits**
				L	T	P	
1	Dissertation	DIS-IN-602	Dissertation – II	0	0	28	14
			Total	**0**	**0**	**28**	**14**

List of Courses for Open Elective

OEC-801	Business Analytics
OEC-802	Industrial Safety
OEC-803	Operations Research
OEC-804	Cost Management of Engineering Projects
OEC-805	Composite Materials
OEC-806	Waste to Energy

List of Courses for Open Elective

AUD-901	Project Management
AUD-902	Disaster Management
AUD-903	Sanskrit for Technical Knowledge
AUD-904	Value Education
AUD-905	Constitution of India
AUD-906	Pedagogy Studies
AUD-907	Stress Management by Yoga
AUD-908	Personality Development through Life Enlightenment Skills

EXAMINATIONS

Examination system: Students are informed to see the examination scheme given in the rules and regulation book published by the institute.

Semester-I
Professional Core Course I, II & III

PCC-IN501 Process Instrumentation (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction to performance characteristics of different transducers and systems, Dynamic analysis of measurement systems, errors in instrumentation systems

UNIT-II Introduction to process control, representative process control problems, classification of process control strategies, Major steps in control system developments

UNIT-III Introduction to Unit Operations and theoretical modeling, concept of Unit and Unit Operation, Material Balance and Energy Balance, Introduction to Evaporation, Distillation, Crystallization processes and associated Instrumentation and control, Introduction to process equipments like Continuous Stirred Tank Reactor (CSTR), Heat Exchanger, liquid storage systems and their modeling, dynamic behavior of first and second order processes, dynamic response of the processes, development of empirical models for process data

UNIT-IV Overview of process control system design: introduction, degree of freedom for process control, selection of controlled, manipulated and measured variable, process safety and process control

UNIT-V Control system instrumentation, introduction, basic control modes, on-off controller, features of PID controller, PID controller design, tuning and trouble shootings, digital version of PID controller, electronic/pneumatic/hydraulic controller, optimum control settings, transducers, transmitters, transmission lines, final control elements and their calculations and selection

UNIT-VI Feed forward and ratio control, cascade control: introduction to Feed forward and ratio control, cascade control and their design consideration, tuning.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. Process dynamics and control by Dale E. Seborg, Thoman F. Edgar, Dyncan A. Mellichamp, IInd Edition, Willey publication
2. Instrument Engineers Handbook by B. G. Liptak Vol. I and II, Third Edition, Chilton and Book Company, 1990.
3. Process control by Peter Harriot Tata McGraw hill
4. Automatic process control by D. Ekman,Wiley Eastern Ltd
5. Process control system Application, Design and tunning by F.G. Shinsky McGraw hill
6. Unit operation and chemical engineering by Mc Cabe McGraw hill Publication
7. Chemical process industries by Shreve McGraw hill Publication

Course Outcomes

The students shall be able to-

PCC-IN501.1 Describe the application of different transducers, calculation of errors in measurement.

PCC-IN501.2 Understand the constructional details, principle of operation, and performance of different unit operations and their Instrumentation.

PCC-IN501.3 Experimental determination of transfer functions of the sensors or systems.

PCC-IN501.4 Classify process control problems, process control strategies.

PCC-IN501.5 Select controlled, manipulated and measured variable among the process variables to have control on process and safety in operation.

PCC-IN501.6 Design and tune appropriate controller for process control application.

PCC-IN502 Advanced Digital Signal Processing (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction: Overview of Discrete-Time LTI systems, Fourier representation of Discrete-Time Signals and z-transform. Techniques to compute inverse z-transform. Discrete Fourier Transform (DFT) and computation of DFT using Fast Fourier Transform (FFT).

UNIT-II Signal Modeling: Pade Approximation, Prony's method and Shanks' method. Stochastic models: Autoregressive (AR), Moving Average (MA) and Autoregressive Moving Average models (ARMA).Linear Prediction: forward and backward linear prediction, solutions of the normal equations (Levinson-Durbin algorithm). Power Spectrum Estimation: Parametric and non-parametric methods.

UNIT-III Multirate digital signal processing: Fundamentals of Multirate systems, Basic multirate operations, Decimation, interpolation, filter design and implementation of sampling rate conversion, polyphase filter structures, time variant filter, structures, multistage implementation of sampling rate conversion of BP signals, sampling rate conversion by an arbitrary factor, interconnection of building blocks, polyphase representation, multistage implementations.

UNIT-IV Wavelet Transform: Introduction to wavelets, wavelets and wavelet expansion systems, discrete wavelet transform, multiresolution formulation of wavelet systems, HaarWavelet and other wavelet representations, scaling function, wavelet functions.

UNIT-V Multirate filter banks: Maximally decimated filter banks, errors created in QMF banks, simple alias free QMF system, power symmetric filter banks, M channel filter banks, polyphase representation, PR systems, alias free filter banks, Linear phase PR QMF banks, Wavelet transform and its relation to multirate filter banks. Applications of multirate signals processing narrowband LPF, suband coding of speech.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. Multirate Systems and Filter Banks: P. P. Vaidyanathan, PH International, Englewood Cliffs, New Jersey, 1993.
2. Wavelet Tour of Signal Processing, Stephene Mallat, Academic Press, 1999.
3. Introduction to Wavelets and Wavelet Transform: C. S. Burrus, Ramesh and A. Gopinath, Prentice Hall Inc. 1998.
4. Digital Signal Processing: Principles, Algorithms, and Applications: J. G. Proakis and D. G. Manolakis; Prentice Hall of India Ltd, 1995.
5. Discrete-Time Signal Processing; A. V. Oppenheim and R. W. Schafer; Prentice Hall of India Ltd, 1997.

Course Outcomes

The students shall be able to-

PCC-IN502.1 Identify, formulate and solve engineering problems in the area signal processing.

PCC-IN502.2 Explain the use of techniques, skills and modern engineering tools such as Matlab and digital processors.

PCC-IN502.3 Apply knowledge of mathematics, science, and engineering to the analysis and design of digital system

PCC-IN502.4 Ability to function on multi-disciplinary teams.

PCC-IN502.5 Design a system, components or process to meet desired needs within realistic constraints such as economic, environmental, social political, ethical, health and safety, manufacturability and sustainability

PCC-IN502.6 Evaluate the discrete Fourier transform (DFT) of a sequence, relate it to the DTFT, and use the DFT to compute the linear convolution of two sequences.

PCC-IN503 Modern Control Theory (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Mathematical Preliminaries: Linear vector spaces and linear operators: Fields, vectors and vector spaces, Linear dependence, Dimension of linear space, The notion of bases, Linear transformation and matrices, Scalar product and norms, Quadratic function and definite matrices, vector and matrix norms, Gram determinant, Solution of linear algebraic equation: Range space, Rank, Null space and nullity of a matrix, Homogenous and nonhomogeneous equations, Eigen values and Eigenvectors and a canonical form representation of linear operators, Functions of square matrix: Caley-Hamilton theorem.

UNIT-II State Space Description for multivariable Control Systems: The concept of state and state models, State equations for dynamic systems, State equations using phase, physical and canonical variables, Plant models of some illustrative control systems, State space representation and realization of transfer matrices, INCimal realization, Solution of state equation.

UNIT-III Multivariable Control Systems Analysis: Concept of Controllability and Reachability, Observability and Constructibility, Controllable and Uncontrollable subspace, Observable and unobservable subspace, Controllability and Observability tests: Kalman's test matrix, Gilbert's test, Popov-Belevitch-Hautus test, Controllability and observability canonical forms, Stability and stabilizability theory.

UNIT-IV Multivariable Control Systems Design: Linear state variable feedback: The effect of state feedback on controllability and observability, Necessary and Sufficient condition for arbitrary pole placement, Ackermann's formula for pole placement, State observers: Full order state observers and minimum order observers, Study of some physical plant like inverted pendulum for analysis and design.

UNIT-V State Space and Matrix-Fraction Descriptions of Multivariable systems: State observability, controllability and matrix-fraction descriptions, Some properties of polynomial matrices, Some basic state space realization, The Smith-McMillan form of a transfer function matrix, Poles and Zeros of a transfer function matrix, Matrix-fraction description (MFD) of a transfer function, State space realization from a transfer function matrix, Internal stability, The generalized Nyquist and inverse Nyquist stability criterion.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. C. T. Chen, Linear System Theory and Design, Holt, Rinehart and Winston, New York, 1984.
2. T. Kailath, Linear Systems, Prentice-Hall, Englewood Cliff's, NJ, 1980.
3. M. Gopal, Modern Control System Theory, Second Edition, New Age International (P) Limited, New Delhi, 1996.
4. W. A. Wolovich, Linear Multivariable Systems, Springer-Verlag, and Berlin, 1974.
5. P. J. Antsaklis and A. N. Michel, Linear Systems, McGraw-Hill International Editions, 1998.
6. K. Ogata, Modern Control Engineering, Third Edition, Prentice-Hall of India, New Delhi, 1997.

Course Outcomes

The students shall be able to-

PCC-IN503.1 Understand the basics of Linear Algebra for application in control system.

PCC-IN503.2 Modeling of linear control systems using state space representation.

PCC-IN503.3 To carry out analysis of multi variable systems using concept of controllability, observability and stability.

PCC-IN503.4 Analyze dynamics of a linear system by solving system model/equation or applying domain transformation.

PCC-IN503.5 Analyze and design multivariable control system using state feedback and state observers.

PCC-IN503.6 To understand relationship between state space and matrix fraction description of multivariable systems..

Professional Elective Course I
(A student will have to select any one elective subject from following for part I)

PEC-IN504-1 Biomedical Instrumentation (4 Credits, L3-T0-P2)

Syllabus

UNIT-I A perspective on Medical Instrumentation, Biomedical Instrumentation, Classification of Biomedical Instruments, Justification of biomedical instrumentation, Scope for Biomedical Engineers.

UNIT-II The Human Body: The cell, Body fluids, Anatomy, Physiology.

UNIT-III Electrodes for Biophysical sensing, Medical surface electrodes, microelectrodes, Transducers and other sensors, Bioelectric amplifiers.

UNIT-IV Basic Principal, Construction and operation, of
i.BP Apparatus ii. Audiometers iii. Dialyser iv. Pacemaker v. Difibrillator
vi. Phonocardiograph vii. Spirometer

UNIT-V Electrocardiography, Basic electrocardiography, ECG lead systems, ECG signal analysis.

UNIT-VI Hospital equipment safety and organization. Electrical hazards of medical instruments, macroshock hazards, microshock hazards, Devices to protect against electrical hazards, an equipment safety program, preventive maintenance.
Diagnostic instruments: ultrasound, X-ray, CT scan, MRI, PET Techniques.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. J. G. Webster, Biomedical Instrumentation, John Wiley and Sons, Hoboken, NJ, 2004.
2. J. Carr and J. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2000.
3. R. S. Khandpur, Hand book of Biomedical Instrumentation, Prentice Hall of India Pvt Ltd, New Delhi, India, 1996.
4. W.J. Tompkins, Biomedical Digital Signal Processing, PHI Prentice Hall of India Private Limited, New Dehli 2006.
5. R. M. Rangayan, Biomedical Signal Analysis: A case study approach, Wiley India Private Limited, New Delhi 2001.
6. A. C. Guyton, J. E. Hall, Textbook of Medical Physiology, 11th edition, Elsevier India 2006.
7. R. Aston, Principles of Biomedical Instrumentation and Measurement, Merrill publishing company, Columbus 1990.

Course Outcomes

The students shall be able to-

PEC-IN504-1.1 Recite the basic need of biomedical instrumentation. Purpose of biomedical instrumentation.

PEC-IN504-1.2 Understand the physiology of biomedical system and different methods in the design of biomedical instruments.

PEC-IN504-1.3 Demonstrate the use of biomedical equipment for bio potential measurements and prediction of diseases.

PEC-IN504-1.4 Dissect the operation, maintenance, selection and calibration of biomedical instruments.

PEC-IN504-1.5 Evaluate the electrical safety measures and maintenance aspects of various equipment used in the hospitals.

PEC-IN504-1.6 Design of various techniques in biomedical instruments for diagnosis purpose.

PEC-IN504-2 Adaptive Control Systems (4 Credits, L3-T0-P2)

Syllabus

UNIT-I 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?

UNIT-II Model Reference Adaptive System: Different configuration of model reference adaptive systems; classification of MRAS, Mathematical description, and Equivalent representation as a nonlinear time-varying system, direct and indirect MRAS.

UNIT-III Analysis and Design of Model Reference Adaptive Systems: Model reference control with local parametric optimization (Gradient method), MIT rule, MRAS for a first order system, MRAS based on Lyapunov stability theory, Design of a first order MRAS based on stability theory, Hyper stability approach, Monopoli's augmented error approach.

UNIT-IV Self-Tuning Regulators: Introduction: The basic idea; process models, disturbance models, General linear difference equation models, model simplification, Different approaches to self-tuning, Recursive Parameter Estimation Methods: The RLS method, extended Least squares, Recursive instrumental variable method; U-D factorization, Covariance resulting, variable data forgetting. Estimation accuracy, Direct and Indirect Self-tuning regulators, Clarke and Gawthrop's Self tuning Controller, Pole Placement approach to self-tuning control; Connection between MRAS and STR.

UNIT-V Gain Scheduling: Introduction, The Principal, Design of Gain Scheduling Regulators, Nonlinear transformations, Applications of gain scheduling.

UNIT-VI Alternatives to Adaptive Control: Why not Adaptive Control? Robust High gain feedback control, Variable Structure schemes,

UNIT-VII Practical aspects, application and Perspectives on adaptive control.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

References Books

1. I. B Landau, Adaptive Control - The Model Reference Approach, New York; Marcel Dekker, 1979.
2. K. J. Astrom and B. Wittenmark, Adaptive Control, Addison Wesley Publication Company, 1989.
3. B. Roffel, P. J. Vermeer, P. A. Chin, Simulation and Implementation of self-Tuning Controllers, Prentice-Hall, Englewood cliffs, NJ, 1989.
4. R. Isermann, K. Lashmann and D. Marko, Adaptive Control Systems, Printice-Hall International (UK) Ltd. 1992.
5. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems

Course Outcomes

The students shall be able to-

PEC-IN504-2.1 Get knowledge of adaptive control system, essential aspect of adaptive control system and its classification.

PEC-IN504-2.2 Understand model reference adaptive systems, classification of MRAS, Mathematical description, and equivalent representation as a nonlinear time-varying system, direct and indirect MRAS.

PEC-IN504-2.3 Demonstrate Practical aspects, application and Perspectives of adaptive control.

PEC-IN504-2.4 Analyze and Design of Model Reference Adaptive Systems: Model reference control with local parametric optimization (Gradient method), MIT rule.

PEC-IN504-2.5 Evaluate performance of self tunning regulators by means of recursive parameter estimators.

PEC-IN504-2.6 Design gain scheduling regulators.

PEC-IN504-3 Computational Methods of Optimization (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction to Optimization: Engineering applications of optimization, Statement of an optimization problem, Classification of optimization problems, optimization techniques.

UNIT-II Linear Programming I: Simplex Method: Standard form of linear programming problem, Geometry of linear programming problem, Definitions and Theorems, Solution of a system of linear simultaneous equations, Motivation to the simplex method, Simplex algorithm, and the two phases of the simplex method.

UNIT-III Linear Programming II: Additional Topics: Revised Simplex method, Duality in linear programming, Decomposition Principle, Sensitivity or post optimal analysis, Transportation problem.

UNIT-IV Nonlinear Programming I: One Dimensional minimization: Unimodal function, EliINCation method, Interpolation methods.

UNIT-V Nonlinear Programming II: Unconstrained Optimisation Technique: Introduction, Direct search methods, Descent methods.

UNIT-VI Nonlinear Programming III: Constrained Optimisation Techniques: Characteristics of a constrained problem, Direct methods, Indirect methods.

UNIT-VII Dynamic Programming: Introduction, Multistage Decision process, Concept of suboptimization and principle of optimality, Computational procedure in dynamic programming. Linear Programming as a case of dynamic programming, Continuous dynamic programming

UNIT-VIII Introduction to Genetic Algorithms and its use in optimisation.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. S. S. Rao, Optimization theory and applications, Second Edition, Wiley Eastern Limited, New Delhi, 1989.
2. M. Wagner, Principles of Operation Research, Second Edition, Tata McGraw hill, 1983.

Course Outcomes

The students shall be able to-

PEC-IN504-3.1 Understand why optimization is so hard.

PEC-IN504-3.2 Learn to convert written descriptions into optimization problems.

PEC-IN504-3.3 Learn to solve optimization problems using black-box software.

PEC-IN504-3.4 Understand many of the fundamental optimization algorithms, such as quasi-Newton methods and linear programming.

PEC-IN504-3.5 Learn about constrained optimization.

PEC-IN504-3.6 Understand why convex optimization is an important modern development

PEC-IN504-4 Process Modeling and Optimization (4 Credits, L3-T0-P2)

Syllabus

UNIT-I **Modeling Aspects**:
Definition of process model, physical and mathematical modeling, deterministic and stochastic process, classification of models, model building, black-box model, white box model, gray model, and classification of mathematical methods.

UNIT-II **Mathematical Models of Chemical Engineering Systems:**
Introduction, uses of mathematical models, scope of coverage, principles of formulation, fundamental laws, continuity equations, energy equations, equation of motion, transport equation, equation of state, equilibrium, kinetics

UNIT-III **Examples of Mathematical Models of Chemical Engineering Systems**:
Introduction, series of isothermal, constant-hold up CSTR, CSTR with variable holds up, two heated tanks, gas-phase, pressurized CSTR, non-isothermal CSTR, single-component vaporizer, batch reactor, reactor with mass transfer, ideal binary distillation column ,batch distillation with holdup.

UNIT-IV **Partitioning and Tearing**:
Steady state lumped system-partitioning equation, tearing equation, simultaneous equation, modular approaches & equation solving approaches, decomposition of networks.

UNIT-V **The Nature and Organization of Optimization Problems**:
Scope and hierarchy of optimization, examples of applications of optimization, the essential features of optimization problems, general procedure for solving optimization problems, obstacles to optimization.

UNIT-VI **Developing Models for Optimization:** Classification of models, how to build a model, selecting functions to fit empirical data, factorial experimental designs, degrees of freedom, examples of inequality and equality constrains in models, formulation of the objective function.

Basic Concepts of Optimization: Continuity of function, NLP problem statement, convexity and its applications, interpretation of the objective function in terms of its quadratic approximation, necessary and sufficient conditions for an extremum of an unconstrained function.

UNIT-VIII **Optimization of Unconstrained Functions**:
One-Dimensional search numerical methods for optimizing a function of one variable, scanning and bracketing procedures, Newton and Quasi-Newton methods of uni-dimensional search, polynomial approximation methods, how one-dimensional search is applied in a multidimensional problem, evaluation of uni-dimensional search methods. Methods using function values only, methods that use first derivatives, Newton's method, Quasi-Newton methods.

Application of Optimizations:
Examples of optimization in chemical processes like: optimizing recovery of waste heat, optimal shell and tube heat exchanger design, optimal design and operation of binary distillation column, chemical reactor design and operation.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. B. Wayne Bequette, Process Dynamics: Modeling, Analysis and Simulation, Prentice Hall International Inc.
2. B. V. Babu, "Process Plant Simulations" Gulf Publications
3. William L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", McGraw Hill International Editions
4. R. Turton, R. C. Bailie, W. B. Whiting and J. A. Shaeiwitz, "Analysis, Synthesis and Design of Chemical Processes", Prentice Hall International In.
5. W. D. Seider, J. D. Seader and D. R. Lewin, "Product and Process Design Principles-Synthesis, Analysis, and Evaluation", John Wiley and Sons Inc.
6. Edger, Himmelblau, Lasdon, "Optimization of Chemical Processes", McGraw-Hill International Edition.
7. Gordon S. G. Beveridge and Rober S. Schechter "Optimization: Theory and Practice", McGraw-Hill Book Company.
8. S. S. Rao , "Engineering Optimization: Theory and Practice", Wiley Eastern Ltd.

Course Outcomes

The students shall be able to-

PEC-IN504-4.1 Simulate the chemical processes, different parts of the processes and unit operations.

PEC-IN504-4.2 Have an understanding of computational techniques to solve the process models.

PEC-IN504-4.3 Use principles of engineering to develop equality and inequality constraints.

PEC-IN504-4.4 Get familiar with the optimization techniques to solve linear programming and nonlinear programming problems.

PEC-IN504-4.5 Think about and use optimization as a tool in process design and operation.

PEC-IN504-4.6 Get proficient in the applications of optimization for optimizing important industrial processes.

Professional Elective Course II

(A student will have to select any one elective subject from following for part II)

PEC-IN505-1 Artificial Intelligence in Control (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction and Fundamentals of Artificial Neural Networks, Biological prototype, Artificial Neuron Single Layer ANN, Multi-layer ANN, training of Artificial NN.

UNIT-II Perceptrons: Perceptron representation, perceptron learning, perceptron training algorithm. Back Propagation: Introduction to Back propagation and back propagation training algorithm, counter propagation networks. Kohonen self-organizing networks: Introduction to the kohonen algorithm, weight training, gross berg layer, Training the Gross berg layer.

UNIT-III Adaptive Resonance Theory (ART): Architecture of Adaptive resonance theory, Algorithm for training of ART, Applications.

UNIT-IV Introduction: Motivation, Fuzzy Systems, Fuzzy control from an industrial perspective, Uncertainty and Imprecision, Uncertainty in information, Chance Versus Ambiguity, The mathematics of fuzzy control. Classical sets and fuzzy sets: Vagueness, Fuzzy set theory versus Probability theory, Operation and properties of classical and fuzzy sets.

UNIT-V Classical relations and fuzzy relations: Cartesian Product, Crisp relations, Fuzzy relations, Operations on fuzzy relations, Various types of binary fuzzy relations, Fuzzy relation equations, The extension principle and its applications, Tolerance and equivalence relations, Crisp equivalence relation, Crisp tolerance relation, Fuzzy tolerance and equivalence relation, Value assignments.

UNIT-VI Fuzzy logic and Approximate reasoning: Introduction, Linguistic variables, Fuzzy logic: Truth-values and truth tables in fuzzy logic, Fuzzy propositions. Inference rules, the compositional rule of inference, representing a set of rule, Properties of a set of rule.

UNIT-VII Fuzzy knowledge based controllers (FKBC) design parameters: Introduction, Structure of a FKBC, Fuzzification and defuzzification module, Rule base, Choice of variable and contents of rules, derivation of rules, data base, choice of membership function and scaling factors, choice of fuzzification and defuzzification procedure and various methods.

UNIT-VIII Process modelling and control: Introduction; Overview of process control applications; Why neural networks in process control? Process Modelling by neural network; Direct Adaptive Control; Self Tuning Controller; Indirect Adaptive Control; Model Reference Adaptive Control; Internal Model Control; Model Predictive Control; Cascade Control.

UNIT-IX Neuro-fuzzy and fuzzy-neural control systems: Adaptive fuzzy systems, optimising the membership functions and the rule base of fuzzy logic controllers using neural networks, fuzzy transfer functions in neural networks, elements of evolutionary computation, case studies.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference books

1. J.M. Zurada, Introduction to Artificial Systems, Singapore: Info Access and distribution, 1992.
2. James A. Anderson, An introduction to neural networks, Prentice Hall of India, Private limited, New Delhi, 1999.
3. S. Haykin, Neural Networks: A Comprehensive Foundation, Macmillan College Publishing Company, 1994.
4. D. Drainkov, H. Hellendoorn and M. Reinfrank, An Introduction to Fuzzy Control, Narosa Publishing House, 1993.
5. T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, Inc 1995.
6. H. J. Zimmermann, Fuzzy set theory and its applications, second edition, Allied Publishers limited, New Delhi, 1996.
7. T. Terano, K. Asai and M. Sugeno, Fuzzy systems theory and its application, Academic Press, 1992.
8. G. J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall of India, New Delhi, 1997.

Course Outcomes

The students shall be able to-

PEC-IN505-1.1 Get comprehensive knowledge of artificial neural network and fuzzy systems.

PEC-IN505-1.2 Understand the basic concepts of Perceptron, training in neural networks and classical set theory, probability theory with fuzzy set theory.

PEC-IN505-1.3 Apply the knowledge of Adaptive Resonance Theory and its application, and fuzzy set theory to interpret classical as well as fuzzy relations.

PEC-IN505-1.4 Deduce fuzzy logic, fuzzy proposition, fuzzy inference rule and properties of a set of rules.

PEC-IN505-1.5 Evaluate the fuzzy knowledge based controller performance for different application.

PEC-IN505-1.6 Compose knowledge of neural networks and fuzzy systems for process modeling applications with designing various controllers.

PEC-IN505-2 Optimal and Robust Control (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Linear Quadratic Control: The Linear Quadratic Regulator (LQR) problem: LQR solution using the minimum principle, Generalization of LQR; LQR properties with classical interpretations; Optimal observer design- Kalman-Bucy filter: Problem formulation and Solution, The Linear Quadratic Gaussian (LQG) problem: Introduction, LQG problem formulation and solution, Performance and Robustness of optimal state feedback, Loop Transfer Recovery (LTR).

UNIT-II Robust/H∞ Control: Introduction, Critique of LQG, Performance specification and robustness: Nominal performance of feedback system; Nominal performance: Multivariable case, Novel problem formulation of classical problem, Modeling uncertainty, Robust stability, Mathematical background: Singular Value Decomposition (SVD); Singular values and matrix norms; The supremum of functions, Norms and spaces, H_2 Optimization and Loop Transfer Recovery (LTR), H∞ Control: A brief history, Notation and terminology, The two-port formulation of control problems; H∞ control problem formulation and assumptions; Problem solution, Weights in H∞ control problems, Design example.

UNIT-III Robust Control: The Parametric Approach: Stability theory via the boundary crossing theorem, The stability of a line segment, Interval polynomials: Kharitonov's theorem for real and complex polynomials, Interlacing and Image set interpretations, Extremal properties of the Kharitonov polynomial, Robust-state feedback stabilization, Schur stability of interval polynomials, The Edge theorem, The Generalized Kharitonov theorem, State space parameter perturbations, Robust stability of Interval matrices, Robustness using the Lyapunov approach, Robust parametric stabilization.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. J. M. Maciejowski, Multivariable Feedback Design, Addison-Wesley Publishing Company, 1989.
2. H. Kwakernaak and R. Sivan, Linear Optimal Control Systems, Wiley-Interscience, 1972.
3. B. D. O. Anderson and J. B. Moore, Linear Optimal Control, Prentice-Hall, 1990.
4. S. P. Bhattacharya, H. Chapellat and L. H. Keel, Robust Control: The Parametric Approach, Prentice-Hall, PTR, NJ07458, 1995.
5. K. Zhou, J. C. Doyle and K. Glover, Robust and Optimal Control, Prentice-Hall, NJ07458, 1996.
6. J. Ackermann, Robust Control: Systems with Uncertain Physical Parameters, Springer-Verlag, London, 1993.
7. F. L. Lewis and V. L. Syrmos, Optimal Control, Second Edition, John Wiley and Sons, Inc. 1995.

Course Outcomes

The students shall be able to-

PEC-IN505-2.1 Design and implement system identification experiments.

PEC-IN505-2.2 Use input-output experimental data for identification of mathematical dynamical models.

PEC-IN505-2.3 Use singular value techniques to analyze the robustness of control systems.

PEC-IN505-2.4 Incorporate frequency-domain-based robustness specifications into multivariable control system designs.

PEC-IN505-2.5 Use H-infinity methods to design robust controllers.

PEC-IN505-2.6 Explain the advantages and disadvantages of robust control relative to other control approaches.

PEC-IN505-3 Probability, Statistics and Stochastic Processes (4 Credits, L3-T0-P2)

Syllabus

UNIT-I	Probability and random variables: Meaning of probability, axioms of probability, repeated trials, concept of random variable, Distributions and density functions, Conditional probability and total probability.
UNIT-II	Functions of one random variable: random variable g(x), distribution of g(x), mean, variance, moments, characteristic functions, two random variables, bivariate distribution, one function of two RVs, two functions of two RVs
UNIT-III	Moments and conditional statistics, joint moments, joint characteristic functions, conditional distributions, conditional expected values.
UNIT-IV	Sequences of RVs: Conditional penalties, characteristic functions and normality, Mean square estimation, stochastic convergence and limit theorems, random numbers: meaning and generation,
UNIT-V	Introduction to stochastic processes: Definition and classification, Markov chains, Stationary distribution and ergodicity, Wiener process, Gaussian process, Elements of time series.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. A. Papoulis, Probability, Random variables and stochastic processes, McGraw Hill, 1991.
2. Starks and Woods, Probability and Estimation Theory, Prentice-Hall
3. M. R. Spiegel, Probability and Statistics, Schaum's Outline Series, McGraw -Hill Book Company, 1982.

Course Outcomes

The students shall be able to-

PEC-IN505-3.1	Convert engineering statement problem into precise mathematical probabilistic statement.
PEC-IN505-3.2	Use statistical principles and the properties of RV to solve probabilistic problem.
PEC-IN505-3.3	Compute standard statistics from distribution and density functions.
PEC-IN505-3.4	Recognize and interpret a variety of random process that occur in engineering application.
PEC-IN 505-3.5	Model stochastic process as an output of a linear system.

PEC-IN505-4 Internet of Things (4 Credits, L3-T0-P2)

Syllabus

UNIT-I IoT Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT-II IoT Applications for Value Creation Introduction, IoT applications for industry: Future Factory Concepts, Brown field IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT-III Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

UNIT-IV Architectural Approach for IoT Empowerment Introduction, Designing a Common Architectural Ground, IoT Standardization, M2M Service Layer Standardization, OGC Sensor Web for IoT, IEEE, IETF and ITU-T standardization activities, Interoperability Challenges, Physical vs Virtual, Solve the Basic First, Data Interoperability, Semantic Interoperability, Organizational Interoperability, Eternal Interoperability, Importance of Standardisation, Plan for validation and testing, Important Economic Dimension, Research Roadmap for IoT Testing Methodologies. Semantic as an Interoperability Enabler and related work.

UNIT-V Introduction, Vulnerabilities of IoT, Security requirements, Challenges for a secure Internet of Things, identity management, Identity portrayal, Different identity management model: Local identity, Network identity, Federated identity, Global web identity, Identity management in Internet of Things, User-centric identity management, Device-centric identity management, Hybrid identity management.

UNIT-VI Trust Management in IoT Introduction, Trust management life cycle, Identity and trust, Third party approach, Public key infrastructure, Attribute certificates, Web of trust models, Web services security, SAML approach, Fuzzy approach for Trust, Access control in IoT, Different access control schemes, Authentication and Access control policies modeling.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. OvidiuVermesan, Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013, ISBN: 978-87-92982-96-4 (E-Book), ISBN: 978-87-92982-73-5.
2. Poonam Railkar, Identity Management for Internet of Thing, River Publishers, 2015, ISBN: 978-87-93102-91-0 (EBook), ISBN: 978-87-93102-90-3.
3. Vijay Medishetti, Arshadeep Bahga, Internet of Things: A Hands-On Approach.
4. CunoP_ster, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1.

Course Outcomes

The students shall be able to-

PEC-IN505-4.1 Present a survey on building blocks of Web Technologies and open source tools.

PEC-IN505-4.2 Write test cases to use technologies for solving problems using Web Technologies.

PEC-IN505-4.3 Write presentations on using Web Technologies with case studies.

PEC-IN505-4.4 Understand the Vulnerabilities of IoT.

PEC-IN505-4.5 Develop Architectural Approach for IoT Empowerment Introduction.

PEC-IN505-4.6 Train and encourage the students to present and discuss the computer assignments and projects to their classmates and on the web.

MCC-590 Research Methodology and IPR (2 Credits, L2-T0-P0)

Course Objective:

1. To explain formulation and analysis of research problem.
2. To describe research ethics and technical writing.
3. To understand IPR and patent rights.
4. To demonstrate new developments in IPR with the help of case studies.

Syllabus

UNIT-I Meaning of research problem, sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT-II Effective literature studies approaches, analysis plagiarism, research ethics.

UNIT-III Effective technical writing, how to write report, paper developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT-IV Nature of intellectual property: Patents, designs, trade and copyright. process of patenting and development: technological research, innovation, patenting, development. international scenario: international cooperation on intellectual property. procedure for grants of patents, patenting under PCT.

UNIT-V Patent rights: Scope of patent rights. licensing and transfer of technology. patent information and databases. geographical indications.

UNIT-VI New developments in IPR: administration of patent system. new developments in IPR; IPR of biological systems, computer software etc. traditional knowledge case studies, IPR and IITs.

Reference Books

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science and engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners".
4. Halbert, "Resisting Intellectual Property", Taylor and Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Course Outcomes

The students shall be able to-

MCC-590-1 Understand research problem formulation.

MCC-590-2 Analyze research related information and follow research ethics.

MCC-590-3 Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

MCC-590-4 Understanding that when IPR would take such important place in growth of individuals and nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general and engineering in particular.

MCC-590-5 Understand that IPR protection provides an incentive to inventors for further research work and investment in R and D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

MAC-591 English for Research Paper Writing (2 Credits, L2-T0-P0)

1. To understand that how to improve your writing skills and level of readability.
2. To learn about what to write in each section.
3. To understand the skills needed when writing a title.
4. To ensure the good quality of paper at very first-time submission.

Syllabus

UNIT-I	Planning and preparation, word order, breaking up long sentences, structuring paragraphs and sentences, being concise and removing redundancy, avoiding ambiguity and vagueness.
UNIT-II	Clarifying who did what, highlighting your findings, hedging and criticizing, paraphrasing and plagiarism, sections of a paper, abstracts. introduction.
UNIT-III	Review of the literature, methods, results, discussion, conclusions, the final check.
UNIT-IV	Key skills are needed when writing a title, key skills are needed when writing an abstract, key skills are needed when writing an introduction, skills needed when writing a review of the literature.
UNIT-V	Skills are needed when writing the methods, skills needed when writing the results, skills are needed when writing the discussion, skills are needed when writing the conclusions.
UNIT-VI	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Reference Books

1. **Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).**
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes

The students shall be able to-

MAC-591-1	Understand how to plan and prepare concise writings by using appropriate words and structured paragraphs.
MAC-591-2	Explain how to write different sections such as abstracts, introduction, survey, methodology, results, conclusions, etc. in paper and reports.
MAC-591-3	Describe key skills needed for writing title of a paper or report.

Semester II
Professional Core Course IV & V

PCC-IN510 Instrumentation System Design (4 Credits, L3-T0-P2)
Syllabus

UNIT-I	Introduction to Instrumentation System Design (ISD), Scope of ISD in Process Industry.
UNIT-II	General transducer Design, Selection of Transducer, General procedure for Testing of transducer.
UNIT-III	Design of RTD, T/C, Thermister based Temperature Instrumentation
UNIT-IV	Design of Pressure Gauge, Bellows, Bourdon Tube, and Diaphragm based Pressure Instrumentation.
UNIT-V	Design of Orifice, Rotameter, Venturi meter flow Instrumentation
UNIT-VI	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.
UNIT-VII	Design of Signal Conditioning elements: Deflection Bridges, Amplifiers, AC. Carriers systems, Current Transmitters, Oscillation and Resonation.
UNIT-VIII	Design of Control Panels, Design of Control Room layout, Flameproof design, testing.
UNIT-IX	Comparison of Pneumatic, Hydraulic and Electrical/Electronic Instrumentation systems and their selection for present process industry requirement.
UNIT-X	Project Documentation, Specification Sheet, Index Sheet, Flow Diagram, Schedules used in typical process industry erection.
UNIT-XI	Testing, Erection, Commissioning of typical process industry.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

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, McGraw-Hill 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.
5. John P. Bentley, Principles of Measurement Systems, Addison-Wesley publication, 1999.
6. T. R. Padmanabhan, Industrial Instrumentation: Principles and Design, Springer-Verlag Publications, 1999.
7. B. C. Nakra and K. K. Choudhari, Instrumentation: Measurement and Analysis, Tata McGraw Hill Pub, 1985.

Course Outcomes

The students shall be able to-

PCC-IN510.1	Identify and formulate design specifications for Instrumentation systems that meet accuracy and measurement requirements.
PCC-IN510.2	Understand the principles of operation of sensors.
PCC-IN510.3	Design of various instruments for measurement purpose.
PCC-IN510.4	Understand the process of project documentation, Testing, Erection, Commissioning of typical process industry
PCC-IN510.5	Decide proper instrumentation system for process industry application and needed control panels.
PCC-IN510.6	Design, construct, and verify an Instrumentation system to meet desired specifications, with the aid of computer-aided design techniques.

PCC-IN511 Computer Process Control (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction to Process Control: Incentives for process control, Design aspect of process control systems, Process dynamics and mathematical models, Types of dynamic processes.

UNIT-II Computers in Process Control: Advantages, Implementation problems: Sampling, Quantization, Aspects of control theory: Transfer function approach, State space approach.

UNIT-III Computer Oriented Mathematical Models: Discrete-time Systems: Mathematical representation of sampling process, Sampling of Continuous-time state space systems, transformation of state space models, Input-output models, Pulse transfer function and data holds, Development of pulse transfer function of the zero and first order holds, Sampling frequency consideration and selection of optimum sampling period.

UNIT-IV Closed Loop Response and Stability of Sampled Data Systems: Determination of closed loop transient response, Shur-Cohen-Jury Stability criterion.

UNIT-V Digital Controllers for Process Control Applications: A brief review of three term controller and their realization, Implementation aspects: Refinement of three term algorithms, other Controller's enhancement: linearization, Adaption, Sample rate selection, Consideration of computational accuracy.

UNIT-VI 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.

UNIT-VII Control of Time Delay Systems: Simulation of pure time delay systems, Smith's principle and method.

UNIT-VIII 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.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. P. B. Deshpande and R. H. Ash, Computer Process Control with advanced control applications, Second Edition, Instrument Society of America Publication, 1988.
2. R. Isermann, Digital Control Systems, Vol.I: Fundamentals, Deterministic Control, Springer-Verlag Publications.
3. K. Warwick and D. Rees, Editors: Industrial Digital Control Systems, IEE Control Engineering Series, UK, 1986.
4. J. R. Leigh, Applied Digital Control, Theory, Design and Implementation, Prentice-Hall International, 1985.
5. G. Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall of India, 1998.
6. K. J. Astrom and B. Wittenmark, Computer Controlled Systems: Theory and Design, Second Edition, Prentice-Hall of India, 1994.

Course Outcomes The students shall be able to-

PCC-IN 511.1	Identity the design aspects of process control systems, process dynamics and mathematical models.
PCC-IN 511.2	Understand the advanced control concepts, system identification and process modeling.
PCC-IN 511.3	Determine the closed loop response and stability of sampled data systems.
PCC-IN 511.4	Analyze Digital Controllers for Process Control Applications.
PCC-IN 511.5	Evaluate performance of digital controller for time delayed system by means of simulation.
PCC-IN 511.6	Design digital controllers and advanced controllers for computer process control systems.

Professional Elective Course III

(A student will have to select any one elective subject from following for part II)

PEC-IN512-1 Industrial Automation (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Evolution of instrumentation and control, Role of automation in industries, Benefits of automation. Different types of processes. Typical examples of continuous, batch, discrete and hybrid processes. Study of Process flow, detailed P&ID, Critical loops, Safety and Alarms, Reliability and Fail safe operation requirements, Efficient running and adhering to standards.

UNIT-II Programmable Logic Controllers (PLC): Introduction. Architecture, discrete I/O systems, Analog I/O systems, definition of discrete state process control, discrete state variables, event sequence description Ladder diagram: Background, ladder diagram elements, ladder diagram symbols, development of ladder diagrams, Programming, advanced features and study of at least one industrial PLC.

UNIT-III Introduction to Supervisory control and data acquisition (SCADA).

UNIT-IV Distributed Control System: Introduction and overview, History, System architecture, System elements, Data communication links. Difference between centralized and distributed control system, Overall tasks of digital control systems, Detailed task listing. Displays: Group display, Overview display, Detail display etc, Local control units, Mean time between failures.
Data Highways, Field buses, Multiplexers and Remote Sensing Terminal units, I/O hardware, Set point stations,

UNIT-V HART, Foundation fieldbus, Profibus protocol introduction, frame structure, programming, implementation examples, Benefits, Advantages and Limitations Comparison with other fieldbus standards including Device net, Profibus, Controlnet, CAN, Industrial Ethernet etc Local area networks, Network protocols: MAP/TOP.

UNIT-VI Study of TDC-3000, ABB MOD 300, Yokogova Centum XL (At least one), Case study (One).

UNIT-VII Introduction to Hybrid controllers.

UNIT-VIII Design of PLC/DCS system, design of marshalling cabinet, power consumption calculation, power distribution diagrams, functional design specification.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. D. Popovic and Vijay Bhatkar: Distributed Computer Control for Industrial Automation, Marcel Dekker Inc., 1990.
2. M. Lucas: Distributed Control Systems.
3. B. G. Liptak, Instrument Engineer's Handbook, Process Control, Third Edition, Chilton Book Company, 1996.
4. C. D. Johnson, Process Control Instrumentation technology, Prentice- Hall of India, 1993.
5. C. L. Alberts and D. A. Coggan, Editors: Fundamentals of Industrial Control, ISA Publication, 1992.
6. Hughes: Programmable Controllers, ISA Publications, 1989.
7. Parr, Programmable Controllers: An Engineers Guide, Butterworh-Heinmen Limited, 1993.
8. Garry Dunning, Introduction to Programmable controllers, 2nd Edition, Thomson Asia, Pte, Ltd, Singapore, 2002.

Course Outcomes

The students shall be able -

PEC-IN512-1.1 To define the automation scheme for the type of process.
PEC-IN512-1.2 To understand PLC thoroughly viz. architecture, PLC programming.
PEC-IN512-1.3 To construct SCADA/HMI for an automation problem in hand.
PEC-IN512-1.4 To explain the basics of Distributed Control System architecture and programming.
PEC-IN512-1.5 To compare various protocols and able choose one for particular automation problem.
PEC-IN512-1.6 To design PLC/DCS or Hybrid control system.

PEC-IN512-2 Estimation and Identification (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Discrete Time Random Process: Random Variables Definitions, Ensemble Averages, Jointly Distributed Random Variables, Joint Moments Independent, Uncorrelated and Orthogonal random variable, Linear Mean Square, estimation, Gaussian Random Variables, Parameters Estimation- Definitions, Ensemble Averages, Gaussian Processes, Stationary Processes, the Covariance and autocorrelation matrices, Ergodicity, White Noise, the Power Spectrum, Filtering Ransom Processes, Spectral Realization, Special Types of Random Processes- MA, AR, ARMA, and Harmonic.

UNIT-II Linear Predication and Optimum Linear Filters- Rational Power Spectrum, Relationship between the Filter Parameters and the Autocorrelation Sequence, Forward and Backward Linear Prediction, Solution of the Normal, Equations- Levinson-Durbin Algorithm, the Shur algorithm, Properties of Linear-Prediction Error Filters, AR Lattice and ARMA Lattice Ladder filters, Wiener Filters for Filtering and Prediction- FIR Weiner Filter, IIR Weiner Filter, NoncausalWener Filter.

UNIT-III Signal Modeling and System Identification: - System Identification based on FIR (MA), All-Pole (AR) and Pole-Zero (ARMA) Models- Pade Approximation, Prony's method, Shank's Method, Least-Square Filtering Design for Prediction and Deconvolution.

UNIT-IV Solution for Least Sequences, Estimation Problems: - Definition and Basic Concepts, Matrix Formulation of Least Square Estimation Algorithm, Cholesky Decomposition, LVD Decomposition, QR Decomposition, Gram-Schmidt Orthogonalization, Givers Rotation, Householder's Reflection, Singular Valve Decomposition (SVD).

UNIT-V Power Spectrum Estimation: - Estimation of Spectra form Finite Duration Observations of Signals, Nonparametric Methods for Power Spectrum Estimation, Parametric Method for power spectrum estimation, minimum variance spectral estimation, Eigen analysis algorithms for spectrum estimation.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. Proakis J. G., Rander C. M., F. Ling and Nikins C. L., Advanced Digital Signal Processing, Macmillan Publishing Company, New York, 1992
2. Hayes M. H., Statical Digital Signal Processing and Modelling, John Wiley and Sons INC. New York, 1996.

Course Outcomes

The students shall be able -

PEC-IN 512-2.1 Knowledge of a variety of mathematical models for random phenomenon.

PEC-IN 512-2.2 Ability to classify such models as to issues of stationary, Markovianness, kinds of asymptotic behavior, and sample function continuity and differentiability.

PEC-IN 512-2.3 Ability to make optimal inferences and estimates with respect to such criteria as minimum error probability, and least mean square error (e.g., Wiener and Kalman filtering).

PEC-IN 512-2.4 Elements of optimal design are introduced

PEC-IN 512-2.5 Response of linear systems to random process inputs.

PEC-IN 512-2.6 Be aware of common applications of such models to communication systems, sources of noise such as thermal noise, behavior of queues and particle emission systems.

PEC-IN512-3 Advanced Power Electronics (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction: Modern power semiconductor devices and their characteristics, gate drive specifications, ratings, applications, Design of gate triggering circuits using UJT, PUT, Diac, and Thyristor protection circuits.

UNIT-II Thyristor Commutation Techniques: Principle of Natural commutation, Design of Forced commutation circuits: Self-commutation, Impulse commutation, resonant pulse commutation, Complementary commutation, and External pulse commutation.

UNIT-III Phase Controlled Rectifiers: Single-phase rectifiers: Half wave, Centre tapped, Bridge (half controlled and fully controlled) with R and RL load.
Three phase rectifiers: Half wave, Bridge (half controlled and fully controlled) with R and RL load. Results should be extended to m-phase rectifiers with single quadrant and two quadrant operations, Effect of source inductance, voltage and current harmonics analysis, and dual converters.

UNIT-IV DC Chopper: Basic chopper, continuous and discontinuous current conduction, TRC, CLC methods, classification of choppers, source filter, multiphase choppers, step-up chopper.

UNIT-V Inverters: Single-phase inverters: series, parallel and bridge configurations with R and RL load, PWM inverters. Three phase inverters with 120° and 180° conduction with R and RL load, voltage control and harmonics reduction.

UNIT-VI Cycloconverters: The basic principle of operations of single phase to single phase, three phase to single phase, three-phase to three-phase with circulating and non-circulating mode.

UNIT-VII Speed control of DC motors: Using different rectifiers, principles of regenerative braking, principles of two/ four quadrant chopper drives, control using multiphase choppers, microprocessor control of DC drives.

UNIT-VIII Speed control of AC motors: Stator voltage control, rotor voltage control, frequency control, voltage and frequency control, microprocessor control of AC drives.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books:

1. M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, Prentice Hall of India Private Limited, New Delhi-110 001(India), 2nd Edition, 1994.
2. M. D. Singh, K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Limited, New Delhi (India), 1998.
3. P. S. Bimbhra, Power Electronics, *Khanna Publishers, Delhi-110 006 (India),* 2nd Edition, 1998.
4. M. Ramamooty, An Introduction to Thyristors and Their Applications, Affiliated East-West Press Private Limited, New Delhi-110 020 (India), 2nd Edition, 1991.
5. N. K. De, P. K. Sen, Electric Drives, Prentice Hall of India Private Limited, New Delhi-110 001(India), 1999.
6. G. De, Principles of Thyristorised Converters, Oxford and IBH Publications, 1982.

Course Outcomes

The students shall be able to-

PEC-IN 512-3.1 Recall the basic operation of various power semiconductor devices and passive components.

PEC-IN 512-3.2 Explain the basic principle of switching circuits.

PEC-IN 512-3.3 Develop and design rectifier circuit, inverter circuit and converter circuit.

PEC-IN 512-3.4 Describe the performance objective for power electronics circuits such as efficiency, power factor.

PEC-IN 512-3.5 Evaluate and analyze the operation of cycloconverters.

PEC-IN 512-3.6 Design and analyze the circuit for speed control of AC and DC moters.

PEC-IN512-4 Robotics (4 Credits, L3-T0-P2)

Syllabus:

UNIT-I Introduction:- Basic Concepts such as Definition , three laws, DOF…..etc. , Robotics and automation, Robot anatomy, Classification, structure of robots, point to point and continuous path robotic systems. Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc.

UNIT-II Robot Grippers: - Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system.
Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.Drives:- Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems.

UNIT-III Control Systems:- Types of Controllers, Introduction to closed loop control, second order linear systems and their control, control law partitioning, trajectory-following control, modelling and control of a single joint, Present industrial robot control systems and introduction to force control.

UNIT-IV Kinematics :- Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods.Velocities and Static forces in manipulators: Motion of the manipulator links, Jacobians, singularities, static forces, Jacobian in force domain

UNIT-V Dynamics: - Introduction to Dynamics , Trajectory generations , Manipulator Mechanism Design

UNIT-VI Machine Vision System: - Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation

UNIT-VII Robot Programming : Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages : Introduction to various types such as RAIL and VAL II …etc, Features of each type and development of languages for recent robot systems. Artificial Intelligence: - Introduction to Artificial Intelligence, AI techniques, Need and application of AI.

UNIT-VIII Associated Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics, International Scenario for implementing robots in Industrial and other sectors. Future scope for robotisation.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Text Books:

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

Reference Books:

1. Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, "Robotic Engineering: An Integrated Approach", Prentice Hall India, 2002.

Course Outcomes

The students shall be able to-

PEC-IN 512-4.1 Define robot anatomy and associated parameters.

PEC-IN 512-4.2 Select different requisites of robot Viz. robot grippers, sensors, drives, control system.

PEC-IN 512-4.3 Solve kinematics related to robot design

PEC-IN 512-4.4 Infer machine vision system for robotic application.

PEC-IN 512-4.5 Compare various robot programming languages/ softwares and select a particular one for problem in hand

PEC-IN 512-4.6 Create robot Socio-Economic, industrial and other sector.

Professional Elective Course IV

(A student will have to select any one elective subject from following for part II)

PEC-IN513-1 Digital Image Processing (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction: Digital image representation, fundamental steps in image processing, elements of digital image processing systems, hardware for image processing system - Frame Graber, Characteristics of image digitizer, Types of digitizer, Image digitizing components, Electronic image tube cameras, solid state cameras, scanners.

UNIT-II Digital image fundamentals: Elements of visual perception, a simple image model sampling and quantization some basic relationship between pixels, image geometry, Basic transformations, Perspective transformation, Camera model and calibration, stereo imaging

UNIT-III Image transforms: 2-D Fourier transform, Fast Fourier transform, other separable transforms, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, wavelet Transform- Haar function, Gabor Transform, Hotelling transforms.

UNIT-IV Image enhancement: - Enhancement by point processing, spatial filtering, enhancement in the frequency domain, Color image processing.

UNIT-V Image restoration: Degradation model, diagonalization of circulate and block-circulate matrices, algebraic approach to restoration, inverse filtering, least mean square (wiener) filter, constrained least squared restoration, invractive restoration.

UNIT-VI Image compression: - Redundancies, image compression models, elements of information theory, error-free compression- variable length coding, bit plane coding, lossless predictive coding, lossy compression – pre dictive coding, transform coding, video compression, image compression standards- JPEG, MPEG.

UNIT-VII Image Analysis: Segmentation - detection of discontinuities, edge linking and boundary detection, thresholding, region -oriented segmentation, Representation and description: Representation schemes, descriptors, regional descriptors, pattern and pattern classes, Classifiers.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Pearson Education Asia, 2002.
2. A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India Pvt Ltd, New Delhi, India, 1989.
3. K. R. Castleman, Digital Image Processing, Prentice-Hall International, 1996.

Course Outcomes

The students shall be able to-

PEC-IN513-1.1 Know and understand the basics and fundamentals of digital signal and image Processing, such as digitization, sampling, quantization.

PEC-IN513-1.2 Apply and relate the basic imaging techniques to practical cases, such as, multimedia, video conferencing, pattern and object recognition, etc.

PEC-IN513-1.3 Operate on images using the processing techniques of smoothing, sharpening, Enhancing, reconstructing geometrical alterations, filtering, restoration, segmentation, features extraction, compression, encoding and color /multichannel.

PEC-IN513-1.4 Analyze and design an image processing system for object recognition using mathematical tools such as image transform, 2-D orthogonal transform.

PEC-IN513-1.5 Manipulate images using the computer: reading, writing, printing, and operating on them.

PEC-IN513-1.6 Compile system to perform various image analysis operations like segmentation, edge linking and boundary detection etc.

PEC-IN 513-2 Applied Nonlinear Control (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Introduction: Introduction to nonlinearities and nonlinear phenomenon, Nonlinear system behavior, Why nonlinear control? Examples.

UNIT-II Phase Plane Analysis: Concepts of Phase Plane Analysis: Phase Portraits; Singular Points; Symmetry in Phase Plane Portraits, Methods of Constructing Phase Portraits: Analytical method, the method of Iscolines, Determining time form Phase Portraits, Phase Plane Analysis of linear systems, and Phase Plane Analysis of nonlinear systems, limit cycles and existence of limit cycle: Poincare, Bendixsons theorem.

UNIT-III Describing Function Method: Describing function fundamentals: An example of describing functions; Computing describing functions, Derivations of describing functions of common nonlinearities, Describing function analysis of nonlinear systems: The Nyquist Criterion and its extension: Existence of limit cycles; Stability of limit cycles; Reliability of describing function analysis, Introduction to dual input describing functions, Subharmonic and jump resonance.

UNIT-IV Fundamentals of Lyapunov Theory: Introduction, Nonlinear Systems and Equilibrium Points. Autonomous and Non-autonomous systems, Concept of Stability, Asymptotic stability and exponential stability, Local and global stability, Linearization and Local stability, Lyapunov's linearization method, Lyapunov's direct method, Positive definite functions, and Lyapunov's functions, Equilibrium Point theorems; Lyapunov theorem for local and global stability, Invariant set theorems, System Analysis based on Lyapunov Direct method. Lyapunov analysis of linear time-invariant systems, Generation of Lyapnov functions. Krasovski's Method, The variable gradient method physically motivated Lypunov functions, control design based on Lyapunov's direct method.

UNIT-V 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.

UNIT-VI Feedback Linearization: Intuitive concepts: Feedback linearization and canonical form; Input-state; Input-output linearization, Mathematical tools, Input-state linearization of SISO systems; Generating a linear input-output relation. Normal forms, The zero-dynamics. Stabilization and tracking; Inverse dynamics and Non-minimum phase systems; Case study: Trajectory Control of Robot Manipulator.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books

1. J. E. Slotine and w. Li, Applied Nonlinear Control., Prentice Hall Inc. Englewood cliffs, New Jersey 1995.
2. M. Vidyasagar, Nonlinear System Analysis, Prentice-Hall Inc. Englewood cliffs, New Jersey 1978.
3. Gelb A. and Vander Velde W. E., Multiple Input describing Function and Nonlinear System Design, Machrao-Hill (1968).
4. A. Isidori, Nonlinear Control System: An Introduction, Springer Yerlag, 1989.
5. Gibson, Nonlinear Automatic Control, Tata Ma-Graw Hill, 1963.

Course Outcomes.

The students shall be able to-

PEC-IN513-2.1 Students can derive and describe the methods for PPA and DF

PEC-IN513-2.2 Students can apply the PPA and DF method to specific systems.

PEC-IN513-2.3 Students can derive and describe the feedback linearization

PEC-IN513-2.4 Students can apply the method of feedback linearization to specific systems

PEC-IN513-3 Industrial Data Communication (4 Credits, L3-T0-P2)

Syllabus

UNIT-I	Communication concepts: Serial and parallel transmission, data organization: signals, digital standard signals, data organization: communication codes, data organization: error coding, data organization: Protocol concepts.
UNIT-II	Communications models: ISO OSI model, mail analogy, OSI model, IEEE 802 models.
UNIT-III	Serial communication standards: Basic concepts, TIA/EIA standards, interface signal functions, PC serial communications.
UNIT-IV	Local Area Networks: Layer 1 the physical layer, topologies, transmission media, 802 and industrial LANs, wireless LANs 802.11, Hub, Bridge, Ethernet Switch, Router, IEEE 802.3/Ethernet: A Layer1 and 2 Standard 10BASE5, 10BASE2, 10BASE-T, 10 GbE-10 Gigabit Ethernet Over Fiber, 10 GbE-10 Gigabit Ethernet Over Copper.
UNIT-V	Industrial networks and field buses: Industrial network requirements, HART, ControlNet, EtherNet/IP, PROFIBUS/PROFINET, Foundation Fieldbus, Ethernet-TCP/IP, Modbus RTU Protocol, IEC 61850.
UNIT-VI	Wide Area Networks: Wireline transmission, carrier concepts, wireline modems, modem types, WAN digital lines, cable modems, WANs for mobile and the hinterlands.
UNIT-VII	Internetworking: Layer 2: internetworking equipment, Layer 3 devices, Routing topologies, managed switches, gateways.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books:

1. Lawrence M. Thompson and Tim Shaw, "Industrial Data Communications", ISA Fifth Edition.
2. D. Roddy and J. Coolen, Electronic Communications, Prentice-Hall of IndiaPrivate Limited, Third Edition, 1984.
3. A. S. Tanennbaum, "Computer Networks", Fourth Edition, Prentice Hall of India, New Delhi, 2002.
4. W. Stallings, "Data and Computer communication, Sixth Edition, Pearson Education, New Delhi, 2001.
5. Comer, "Computer Networks and Internets", Second Edition, Pearson Education, 2001.
6. Behrouz A. Forouzen, "Data Communication and Networking" Fourth Edition, McGraw Hill Publications, 2007.

Course Outcomes

The students shall be able to-

PEC-IN 513-3.1	To understand the setting of a network environment with all the necessary data communication components, procedure, conflicting issues and resolution techniques that make it functional.
PEC-IN 513-3.2	To remember and describe how the physical, data link, and network layers operate in a typical data communication system.
PEC-IN 513-3.3	To apply the operation and technique of various communication protocols such as multiple access protocols, TCP, UDP, FTP, etc.
PEC-IN 513-3.4	To analyze the services and features of the various layers of data networks.
PEC-IN 513-3.5	To evaluate communication protocols for route calculations and be able to perform such calculations of data transmission.
PEC-IN 513-3.6	To create the suitable transmission route for different internetworking devices.

PEC-IN513-4 Wireless Instrumentation and Safety (4 Credits, L3-T0-P2)

Syllabus

UNIT-I Frequency of Wireless communication-Development of Wireless Sensor Network based Project-Wireless sensor based on Microcontroller and communication device-Zigbee Communication device

UNIT-II Power sources- Energy Harvesting –Solar and Lead acid batteries-RF Energy /Harvesting-Energy Harvesting from vibration-Thermal Energy Harvesting-Energy Management Techniques-Calculation for Battery Selection.

UNIT-III Tedes IEEE 1412- Brief description of API mode data transmission-Testing the communication between coordinator and remote XBee- Design and development of graphical user interface for receiving sensor data using C++; A brief review of signal processing techniques for structural health monitoring.

UNIT-IV WSN based physiological parameters monitoring system- Intelligent sensing system for emotion recognition-WSN based smart power monitoring system.

UNIT-V Introduction, Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Factories Act, 1948 and Environment (Protection) Act, 1986 and rules thereof. Shock wave propagation, vapour cloud and boiling liquid expanding vapours explosion (VCE and BLEVE), mechanical and chemical explosion, multiphase reactions, transport effects and global rates.

UNIT-VI Preventive and protective management from fires and explosion, inerting, static electricity, passivation, ventilation, and sprinkling, proofing, relief systems, relief valves, flares, scrubbers. TOXICOLOGY, Hazards identification, toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices, Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

UNIT-VII Leaks and Leakages, Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases.

UNIT-VIII Case Studies, Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

Practical: Based on above syllabus minimum eight experiments/tutorials/assignments.

Reference Books:

1. HalitEren, "Wireless Sensors and Instruments: Networks, Design and Applications", CRC Press, Taylor and Francis Group, 2006.
2. UvaisQidwai, Smart Instrumentation: A data flow approach to Interfacing", Chapman & Hall; 1st Edn, December 2013.
3. Crowl D.A. and Louvar J.F., "Chemical Process Safety: Fundamentals with Applications", 2nd Ed., Prentice Hall.2001.
4. Mannan S., "Lee's Loss Prevention In the Process Industries", Vol. I, 3rd Ed., Butterworth Heinemann 2004.
5. Mannan S., "Lee's Loss Prevention in the Process Industries", Vol. II, III 3rd Ed., Butterworth Heinemann 2005.

Course Outcomes

The students shall be able to-

PEC-IN 513-4.1	Get knowledge of wireless sensors and define hazardous area in process industries
PEC-IN 513-4.2	Understand MAC algorithms and Network protocols used for specific WSN applications and Preventive and protective management.
PEC-IN 513-4.3	Develop a WSN for a given application.
PEC-IN 513-4.4	Classify relief and its sizing methods.
PEC-IN 513-4.5	Decide methodology to avoid leakages in hazardous area classified.
PEC-IN 513-4.6	Design safety and hazards regulation by studying various case studies.

PROJ-IN515 Mini Project and Seminar
(2 Credits, L0-T0-P4)

The seminar should be on any topic having relevance with Instrumentation and control engineering. The same should be decided by the student and concerned teacher. Seminar work shall be in the form of report to be submitted by the student at the end of the semester. The candidate will deliver a talk on the topic for half an hour and assessment will be made by two internal examiners appointed by DPGPC, one of them will be guide. Usually the seminars should be related to dissertation topics.

Each of the courses shall have the term work/ sessional, which includes the design/ experiments/ software/ assignments etc. that will have one credit each. The evaluation for which will be separate, however on the grade card one course will include five credits out of which four credits are for course work and one credit will be for term work / sessional.

Semester III

DES-IN601 Dissertation Phase-I (14 Credits, L0-T0-P28)

Dissertation shall consist of:
Research work done by the candidate in the areas related to the program, or Comprehensive and critical review of any recent development in the subject, or Design and/or development of a product related to the program done by the candidate.

Following shall be the guidelines for evaluation of dissertation part I
Dissertation Part I shall consist of the following components (whichever applicable)

1. Extensive literature survey,
2. Data collection from R&D organizations, Industries, etc,
3. Study of the viability, applicability and scope of the dissertation
4. Detailed Design (H/W and S/W as applicable)
5. Partial implementation

A candidate should prepare the following documents for examination

1. A term paper in the format of any standard journal based on the work
2. A detailed report of the work done by the candidate related to dissertation

Every candidate should present himself (for about 30 INC.) before the panel of examiners (which will evaluate the dissertation I for TW and Oral marks) consisting of-

1. Head of Department
2. M. Tech. Coordinator or his nominee
3. All guides
4. At least two examiners from outside the department.

Semester IV

DES-IN602 Dissertation Phase-II (14 Credits, L0-T0-P28)

The dissertation shall be assessed internally by a panel of examiners (similar to the one in dissertation part- I) before submission to the Institute. The candidate shall submit the dissertation in triplicate to the Head of the institution, duly certified that the work has been satisfactorily completed. The Practical examination (viva-voce) shall consist of a defense presented by the candidate or his/her work in the presence of examiners appointed by the University one of whom will be the guide and the other an external examiner.

OEC-801 Business Analytics (3 Credits, L3-T0-P0)

UNIT-I Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT-VI Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course Outcomes

The students shall be able to-

OEC-801.1 Students will demonstrate knowledge of data analytics.

OEC-801.2 Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.

OEC-801.3 Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

OEC-801.4 Students will demonstrate the ability to translate data into clear, actionable insights.

OEC-802 Industrial Safety (3 Credits, L3-T0-P0)

UNIT-I Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost and its relation with replacement economy, Service life of equipment.

UNIT-III Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-V Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-VI Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

UNIT-VI Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Reference Books:

1. Maintenance Engineering Handbook, Higgins and Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman and Hall London.

OEC-803 Operations Research (3 Credits, L3-T0-P0)

Course Syllabus:

UNIT-I Optimization techniques, model formulation, models, general L.R formulation, simplex techniques, sensitivity analysis, inventory control models.

UNIT-II Formulation of a LPP - graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT-III Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

UNIT-IV Scheduling and sequencing - single server and multiple server models - deterministic inventory models - probabilistic inventory control models - geometric programming.

UNIT-V Competitive models, single and multi-channel problems, sequencing models, dynamic programming, flow in networks, elementary graph theory, game theory simulation.

Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

Course Outcomes

The students shall be able to-

OEC-803.1 Apply the dynamic programming to solve problems of discreet and continuous variables.

OEC-803.2 Apply the concept of non-linear programming.

OEC-803.3 Carry out sensitivity analysis.

OEC-803.4 Model the real world problem and simulate it.

OEC-804 Cost Management of Engineering Projects (3 Credits, L3-T0-P0)

Course Syllabus:

UNIT-I Introduction and overview of the strategic cost management process.

UNIT-II Cost concepts in decision-making; relevant cost, differential cost, incremental cost and opportunity cost. objectives of a costing system; inventory valuation; creation of a database for operational control; provision of data for decision-making. project: meaning, different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. project execution as conglomeration of technical and nontechnical activities. detailed engineering activities. pre project execution main clearances and documents project team: role of each member. importance project site: data required with significance. project contracts. types and contents. project execution project cost control. bar charts and network diagram. project commissioning: mechanical and process.

UNIT-III Cost behavior and profit planning marginal costing; distinction between marginal costing and absorption costing; break-even analysis, cost-volume-profit analysis. various decision-making problems. standard costing and variance analysis. pricing strategies: pareto analysis. target costing, life cycle costing. costing of service sector. just-in-time approach, material requirement planning, enterprise resource planning, total quality management and theory of constraints. activity-based cost management, bench marking; balanced score card and value-chain analysis. budgetary control; flexible budgets; performance budgets; zero-based budgets. measurement of divisional profitability pricing decisions including transfer pricing.

UNIT-IV Quantitative techniques for cost management, linear programming, PERT/CPM, transportation problems, assignment problems, simulation, learning curve theory.

Reference Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.
2. Charles T. Horngren and George Foster, Advanced Management Accounting.
3. Robert S Kaplan Anthony A. Alkinson, Management and Cost Accounting.
4. Ashish K. Bhattacharya, Principles and Practices of Cost Accounting A. H. Wheeler publisher.
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OEC-805 Composite Materials (3 Credits, L3-T0-P0)

Course Syllabus:

UNIT-I Introduction: definition – classification and characteristics of composite materials. advantages and application of composites. functional requirements of reinforcement and matrix. effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT-II Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, kevlar fibers and boron fibers. properties and applications of whiskers, particle reinforcements. mechanical behavior of composites: rule of mixtures, inverse rule of mixtures. isostrain and isostress conditions.

UNIT-III Manufacturing of metal matrix composites: casting – solid state diffusion technique, cladding – hot isostatic pressing. properties and applications. manufacturing of ceramic matrix composites: liquid metal infiltration – liquid phase sintering. manufacturing of carbon – carbon composites: knitting, braiding, weaving. properties and applications.

UNIT-IV Manufacturing of polymer matrix composites: preparation of moulding compounds and prepregs – hand layup method – autoclave method – filament winding method – compression moulding – reaction injection moulding. properties and applications.

UNIT-V Strength: Laminar failure criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. laminate first play failure-insight strength; laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley and Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

OEC-806 Waste to Energy (3 Credits, L3-T0-P0)

Course Syllabus:

UNIT-I Introduction to energy from waste: classification of waste as fuel – agro based, forest residue, industrial waste - MSW – conversion devices – incinerators, gasifiers, digestors

UNIT-II Biomass pyrolysis: pyrolysis – types, slow fast – manufacture of charcoal – methods - yields and application – manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III Biomass gasification: Gasifiers – fixed bed system – downdraft and updraft gasifiers – fluidized bed gasifiers – design, construction and operation – gasifier burner arrangement for thermal heating – gasifier engine arrangement and electrical power – equilibrium and kinetic consideration in gasifier operation.

UNIT-IV Biomass combustion: biomass stoves – improved chullahs, types, some exotic designs, fixed bed combustors, types, inclined grate combustors, fluidized bed combustors, design, construction and operation - operation of all the above biomass combustors.

UNIT-V Biogas: properties of biogas (calorific value and composition) - biogas plant technology and status - bio energy system - design and constructional features - biomass resources and their classification - biomass conversion processes - thermo chemical conversion - direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - types of biogas plants – applications - alcohol production from biomass - bio diesel production - urban waste to energy conversion - biomass energy programme in India.

References Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I and II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley and Sons, 1996.

AUD-901 Waste to Energy (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I Concept of Project Management, Principles of Project Management, Functions of Project Management: Planning, Organizing, Staffing, Directing & Controlling, Project Scope Verification , Functional & Matrix Organization Structure.

UNIT-II Project Network Diagram: Precedence Diagramming Method (PDM), Activity-on-Node (AON) & Arrow Diagramming Method (ADM), Work Breakdown Structure (WBS), Gantt Chart, Milestone Chart, Project Network Analysis (Critical Path Method and PERT), Cost Analysis of Project, Resource Allocation, Resource Smoothening & Leveling, Resource Histograms, Use of Computer Software (PRIMAVERA & MICROSOFT PROJECT) in Project Network Analysis.

UNIT-III Thermal Power Project, Fertilizer Project, Turnkey Construction Project, Software Creation & Installation Project, Project Related to Mechanical Industry, Projects Related to Electronic & Communication Industry.

UNIT-IV Project Formulation, Project Plan, Project Appraisal Techniques: Net Present Value, Internal Rate of Return, Payback Period, Benefit Cost Ratio, Value Engineering job plan, Project Life Cycle Costs.

UNIT-V Project Quality Planning, Assurance & Control, Project Quality Management Techniques: Kaizen & Just-in-Time, Total Quality Management, Risk-Management Plan, Uncertainty, Risk Factors and Risk Tolerances, Project Quantitative Risk Analysis (Monte Carlo Analysis & Decision Tree), Project Risk Monitoring & Control, Procurement Management Plan, Project Contract Administration.

UNIT-VI Project Information Cell, Management Information System, Software Project Management, Categorization of Software Projects , Project portfolio Management, Software Process and Process Models, Choice of Process Models: Mental Delivery, Rapid Application Development, Agile Methods, Extreme Programming, SCRUM, Software Estimation, Effort and Cost Estimation Techniques, COSMIC Full Function Points, COCOMO II A Parametric Productivity Model, Project Tracking, Software Configuration Management, Staffing Pattern, Methods of staff selection, The Oldham-Hackman job characteristic model.

Course Outcomes

The students shall be able to-

AUD-901.1 Understand the concepts and functions of project management.

AUD-901.2 Apply the project plan planning and monitoring techniques.

AUD-901.3 Analyze the project value, risk and quality.

AUD-901.4 Design and develop projects at each stage of the software development life cycle (SDLC).

References Books:

1. Chitkara K.K., Construction Project Management, Tata McGraw Hill Publications.
2. Barrie D.S. & Paulson B.C,Professional Construction Management,McGraw Hill.
3. R.Flagnan and G.Norman, Risk Managemnt & Construction, Blackwell Scientific Publishers.
4. L.W. Zimmwerman and G.D. Hart, Value Engineering, CBS Publishers.
5. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication, 2011.
6. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.

AUD-902 Disaster Management (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT-II Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT-III Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.

UNIT-IV Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT-VI Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

References Books:

1. Chitkara K.K., Construction Project Management, Tata McGraw Hill Publications.
2. Barrie D.S. & Paulson B.C,Professional Construction Management,McGraw Hill.
3. R.Flagnan and G.Norman, Risk Managemnt & Construction, Blackwell Scientific Publishers.
4. L.W. Zimmwerman and G.D. Hart, Value Engineering, CBS Publishers.
5. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication, 2011.
6. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.

Course Objective :

AUD-902.1 Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

AUD-902.2 Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

AUD-902.3 Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

AUD-902.4 Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

AUD-903 Sanskrit for Technical Knowledge (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I Alphabets in Sanskrit,

UNIT-II Past/Present/Future Tense

UNIT-III Simple Sentences, Order

UNIT-IV Introduction of roots

UNIT-V Technical information about Sanskrit Literature

UNIT-VI Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Objective :

1	To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
2	Learning of Sanskrit to improve brain functioning.
3	Learning of Sanskrit to develop the logic in mathematics, science and other subjects enhancing the memory power.
4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

Course Outcome :

AUD-903.1	Understanding basic Sanskrit language.
AUD-903.2	Ancient Sanskrit literature about science and technology can be understood.
AUD-903.3	Being a logical language will help to develop logic in students.

AUD-904 Value Education (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments
UNIT-II	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline
UNIT-III	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.
UNIT-IV	Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature
UNIT-V	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation.
UNIT-VI	Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Suggested Reading:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.

Course Objective :

1	To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
2	Learning of Sanskrit to improve brain functioning.
3	Learning of Sanskrit to develop the logic in mathematics, science and other subjects enhancing the memory power.
4	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

Course Outcome :

AUD-904.1	Knowledge of self-development
AUD-904.2	Learn the importance of Human values.
AUD-904.3	Developing the overall personality.

AUD-905 Constitution of India (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I History of Making of the Indian Constitution:
History
Drafting Committee, (Composition and Working)

UNIT-II Philosophy of the Indian Constitution:
Preamble
Salient Features

UNIT-III Contours of Constitutional Rights and Duties:
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

UNIT-IV Organs of Governance:
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT-V Local Administration:
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT-VI Election Commission:
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested Reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcome :

AUD-905.1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

AUD-905.2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

AUD-905.3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

AUD-905.4 Discuss the passage of the Hindu Code Bill of 1956.

AUD-906 Pedagogy Studies (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I Introduction and Methodology:
Aims and rationale, Policy background, Conceptual framework and terminology
Theories of learning, Curriculum, Teacher education.
Conceptual framework, Research questions.
Overview of methodology and Searching.

UNIT-II Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
Curriculum, Teacher education.

UNIT-III Evidence on the effectiveness of pedagogical practices
Methodology for the in depth stage: quality assessment of included studies.
How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-IV Theory of change.
Strength and nature of the body of evidence for effective pedagogical practices.
Pedagogic theory and pedagogical approaches.
Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-V Professional development: alignment with classroom practices and follow-up support
Peer support
Support from the head teacher and the community.
Curriculum and assessment
Barriers to learning: limited resources and large class sizes

UNIT-VI Research design
Contexts
Pedagogy
Teacher education
Curriculum and assessment
Dissemination and research impact.

Suggested Reading:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Objective :

1	Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2	Identify critical evidence gaps to guide the development.

Course Outcome :

AUD-906.1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
AUD-906.2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
AUD-906.3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUD-907 Stress Management By Yoga (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I Definitions of Eight parts of yog. (Ashtanga)

UNIT-II Yam and Niyam.

UNIT-III Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT-IV Do`s and Don't's in life.
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-V Asan and Pranayam
i) Various yog poses and their benefits for mind and body

UNIT-VI Asan and Pranayam
ii) Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading:

1. Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur.
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcome :

AUD-907.1 Develop healthy mind in a healthy body thus improving social health also.

AUD-907.2 Improve efficiency.

AUD-908 Personality Development Through Life Enlightenment Skills (0 Credits, L0-T0-P0)

Course Syllabus:

UNIT-I Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride and heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III Approach to day to day work and duties.

- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,

UNIT-IV Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,

- Chapter 18-Verses 45, 46, 48.

UNIT-V Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT-VI

- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested Reading:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcome :

AUD-908.1 Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.

AUD-908.2 The person who has studied Geeta will lead the nation and mankind to peace and prosperity.

AUD-908.3 Study of Neetishatakam will help in developing versatile personality of students.