PGS 501 **(1+0)**

LIBRARY AND INFORMATION SERVICES

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Theory

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; resources access methods.

PGS 502 **(0+1)**

TECHNICAL WRITING AND COMMUNICATIONS SKILLS

Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

- Various forms of scientific writings- theses, technical papers, reviews, manuals etc.;
- Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
- Writing of abstracts, summaries, précis, citations, etc.;
- Commonly used abbreviations in the theses and research communications;
- Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation
- marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;

- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;
- Presentation of scientific papers.

Suggested Readings

1. Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
2. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
3. Collins' Cobuild English Dictionary. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
6. James HS. 1994. Handbook for Technical Writing. NTC Business Books.
7. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
8. Mohan K. 2005. Speaking English Effectively. MacMillan India.
9. Richard WS. 1969. Technical Writing.
10. Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
11. Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

PGS 503 **(1+0)**

INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE

Objective

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

1. Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
3. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.
4. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
5. Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
6. Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.
1. The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

PGS 504 **(0+1)**

BASIC CONCEPTS IN LABORATORY TECHNIQUES

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co

PGS 505 (1+0)

AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

1. Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.

3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
4. Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

I. Course Title: Big Data Analytics

II. Course Code: CSE 501

III. Credit Hours: 2+1

IV. Aim of the course

To understand principles of analyzing and mining big data and to use simple tools to extract useful information from big data sets.

V. Theory

Unit I

Data analysis, data matrix attributes. Data: Algebraic and geometric view, probabilistic view.

Unit II

Basics of data mining and CRISP-DM, organizational and data understanding, purposes, Intents and limitations of data mining, database, data warehouse, data mart and data set, types of data, privacy and security, data preparation, collation and data scrubbing.

Unit III

Data mining models and methods, correlation, association rules, k-means, clustering understanding of concept, preparation and modelling.

Unit IV

Discriminant analysis, linear regression, logistic regression, understanding, preparation and modeling.

Unit V

Decision trees, neural networks, understanding, preparation and modeling.

VI. Practical

Introduction to Open Office and Rapid Miner in data analytics and mining. Preparing Rapid Miner, Importing data, handling missing data, data reduction, handling Inconsistent data, attribute reduction. Performing different analysis using Rapid Miner or suitable software.

VII. Learning outcome

Capability to understand the principles behind analysis of big data and apply the same using simple tools.

VIII. Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	Data analysis, data matrix attributes	2
2	Algebraic and geometric view, probabilistic view.	4
3	Basics of data mining and CRISP-DM	2
4	Organizational and data understanding	3
5	Intents and limitations of data mining, database, data warehouse, data mart and data set	4
6	Intents and limitations of data mining, database, data warehouse, data mart and data set	4
7	Data mining models and methods, correlation, association rules	6
8	K-means, clustering understanding of concept, preparation and modelling.	5
9	Discriminant analysis, linear regression, logistic regression, understanding, preparation and modeling.	5
10	Decision trees, neural networks, understanding, preparation and modeling.	5
TOTAL		**40**

IX. List of Practicals

Sl. No.	Topic	No. of Practicals
1	Working of Open Office and Rapid Miner	3
2	Preparing Rapid Miner Dataset	3
3	Handling the inconsistent data, missing data, attribute reduction	4
4	Performing analysis on dataset using Rapid Miner	3
TOTAL		13

X. Suggested Reading

- Dr Matthew North Data Mining for the Masses A Global Text Project Book ISBN: 0615684378ISBN-13: 978-0615684376.
- Mohammed J Z, Troy and Wagner M Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Universidade Federal de Minas Gerais, Brazil. Cambridge University Press ISBN 978-0-521-76633-3 Hardback.

I. Course Title: Artificial Intelligence

II. Course Code: CSE 502

III. Credit Hours: 2+1

IV. Aim of the course

To introduce students with techniques and capabilities of artificial intelligence (AI) and enable them to do simple exercises.

V. Theory

Unit I

Definitions of intelligence and artificial intelligence. What is involved in intelligence? Disciplines important to AI. History of development of AI. Different types of AI. Acting humanly, Turing test. AI systems in everyday life. Applications of AI.

Unit II

Classical AI, concept of expert system, conflict resolution, multiple rules, forward chaining, backward chaining. Advantages and disadvantages of expert system. Fuzzy logic and fuzzy rules. Fuzzy expert systems.

Unit III

Problem solving using AI, search techniques, breadth first search, depth first search, depth limited search, bidirectional search, heuristic search, problems and examples. Knowledge representation, frames, methods and demons, correlations, decision trees, fuzzy trees.

Unit IV

Philosophy of AI, Penrose's pitfall, weak AI, strong AI, rational AI, brain prosthesis experiment, the Chinese room problem, emergence of consciousness, technological singularity, Turing test.

Unit V

Modern AI, biological brain, basic neuron model, perceptrons and learning, self-organizing neural network, N-tuple network, evolutionary computing, genetic algorithms, agent methods, agents for problem solving, software agents, multi agents, hardware agents.

VI. Practical

Prolog language, syntax and meaning of Prolog programs, Lists, operators, arithmetic. Using structures: Example programs, controlling backtracking, input and output. more built-in procedures, programming, style and technique, operations on data structures. Advanced tree representations, basic problem-solving strategies, depth-first search strategy, breadth-first search strategy.

VII. Learning outcome

Ability to understand and apply principles of AI in solving simple problems to enable them to get insight into working of AI based systems.

VIII. Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	Definitions of intelligence and artificial intelligence. Disciplines important to AI. History of development of AI.	2
2	Different types of AI. Acting humanly, Turing test. AI systems in everyday life. Applications of AI	2
3	Classical AI, concept of expert system, conflict resolution, multiple rules, forward chaining, backward chaining.	3
4	Classical AI, concept of expert system, conflict resolution, multiple rules, forward chaining, backward chaining.	3
5	Problem solving using AI, search techniques, breadth first search, depth first search	4
6	Depth limited search, bidirectional search, heuristic search, problems and examples.	4
7	Depth limited search, bidirectional search, heuristic search, problems and examples.	3
8	Depth limited search, bidirectional search, heuristic search, problems and examples.	2
9	Depth limited search, bidirectional search, heuristic search, problems and examples.	3
10	Modern AI, biological brain, basic neuron model, perceptrons and learning, self-organizing neural network,	3
11	N-tuple network, evolutionary computing, genetic algorithms,	2
12	Agent methods, agents for problem solving, software agents,	2
13	Multi agents, hardware agents.	1
TOTAL		**31**

IX. List of Practicals

Sl. No.	Topic	No. of Practicals
1	Prolog language, syntax and meaning of Prolog programs, Lists, operators, arithmetic.	4
2	Using structures: Example programs, controlling backtracking, input and output. more built-in procedures, programming, style and technique, operations on data structures.	5
3	Using structures: Example programs, controlling backtracking, input and output. more built-in procedures, programming, style and technique, operations on data structures.	5
TOTAL		**14**

X. Suggested Reading

- GNU PROLOG A Native Prolog Compiler with Constraint Solving over Finite Domains Edition 1.44, for GNU Prolog version 1.4.5 July 14, 2018.
- Ivan Bratko, Prolog Programming for Artificial Intelligence.
- Warwick K. 2012. Artificial Intelligence: The Basics ISBN: 978-0-415-56482-3 (hbk).

I. Course Title: Neuro-Fuzzy Application in Engineering

II. Course Code: CSE 503

III. Credit Hours: 2+1

IV. Aim of the course

To learn the basic concept of neural network models and fuzzy logic based models and apply fuzzy reasoning and fuzzy inference to solve various agricultural engineering problems

V. Theory

Unit I

Basic concepts of neural networks and fuzzy logic, differences between conventional computing and neuro-fuzzy computing, characteristics of neuro-fuzzy computing.

Unit II

Fuzzy set theory: Basic definitions, terminology, formulation and parameters of membership functions. Basic operations of fuzzy sets: Complement, intersection, vision, T-norm and T-conorm. Fuzzy reasoning and fuzzy Inference: Relations, rules, reasoning, Inference systems, and modeling. Applications of fuzzy reasoning and modelling in engineering problems.

Unit III

Fundamental concepts of artificial neural networks: Model of a neuron, activation functions, neural processing. Network architectures, learning methods. Neural network models: Feed forward neural networks, back propagation algorithm, applications of feed forward networks, recurrent networks, hopfield networks, hebbian learning, self-organizing networks, unsupervised learning, competitive learning.

Unit IV

Neuro–fuzzy modelling: Neuro-fuzzy inference systems, neuro-fuzzy control.

Unit V

Applications of neuro-fuzzy computing: Time series analysis and modelling, remote sensing, environmental modelling.

VI. Practical

Training algorithms of artificial neural networks: Basic models, learning rules, single layer and multi-layer feed-forward and feedback networks, supervised and unsupervised methods of training, recurrent networks, modular networks. Fuzzy systems: Fuzzy sets, operations on fuzzy sets, fuzzy relations, measures, fuzzy logic, fuzzy logic controller, integrated hybrid systems. Adaptive neuro-fuzzy inference systems, coactive neuro-fuzzy modelling, classification and regression trees, data clustering algorithms like k-means, fuzzy c-means, mountain and subtractive clustering, rule based structure identification, neuro-fuzzy control, case studies. Use of available software for fuzzy logic and neural networks.

VII. Learning outcome

The students will be able to have the basic concept of neural network models and fuzzy logic-based models and will be in a position to apply fuzzy reasoning and fuzzy inference for various problems of agricultural engineering. They will also learn to develop different types of neural network models.

VIII. Lecture Schedule

Sl. No.	**Topic**	**No. of Lectures**
1	Basic concepts of neural networks and fuzzy logic, differences between conventional computing and neuro-fuzzy computing, characteristics of neuro-fuzzy computing.	3
2	Fuzzy set theory: Basic definitions, terminology, formulation and parameters of membership functions.	3
3	Basic operations of fuzzy sets: Complement, intersection, vision, T-norm and T- conorm. Fuzzy reasoning and fuzzy Inference: Relations, rules, reasoning, Inference systems, and modeling.	4
4	Applications of fuzzy reasoning and modelling in engineering problems.	3
5	Fundamental concepts of artificial neural networks: Model of a neuron, activation functions, neural processing. Network architectures, learning methods.	3
6	Neural network models: Feed forward neural networks, back propagation algorithm, applications of feed forward networks	3
7	recurrent networks, hopfield networks, hebbian learning, self-organizing networks, unsupervised learning, competitive learning.	4
8	recurrent networks, hopfield networks, hebbian learning, self-organizing networks, unsupervised learning, competitive learning.	3
9	Applications of neuro-fuzzy computing: Time series analysis and modelling, remote sensing, environmental modelling.	4
TOTAL		**30**

IX. List of Practicals

Sl. No.	Topic	No. of Practicals
1	Training algorithms of artificial neural networks: Basic models, learning rules, single layer and multi-layer feed-forward and feedback networks, supervised and unsupervised methods of training, recurrent networks, modular networks	5
2	Fuzzy systems: Fuzzy sets, operations on fuzzy sets, fuzzy relations, measures, fuzzy logic, fuzzy logic controller, integrated hybrid systems. Adaptive neuro-fuzzy inference systems, coactive neuro-fuzzy modelling, classification and regression trees,	5
3	data clustering algorithms like k-means, fuzzy c-means, mountain and subtractive clustering, rule based structure identification, neuro-fuzzy control, case studies. Use of available software for fuzzy logic and neural networks	6
TOTAL		**16**

X. Suggested Reading

- Jang, JS R, Sun C Tand Mizutan E 1997. Neuro-Fuzzy and Soft Computing. Prentice Hall
- Simon Haykin NJ. 1994. Neural Networks. A Comprehensive Foundation. McMillan College Publishing Company.
- Klir George J and Forger TA. 1995. Fuzzy Sets, Uncertainty and Information. Prentice Hall of India, Pvt. Ltd, New Delhi.
- Kosko B. 1997. Neural Networks and Fuzzy Systems. Prentice Hall of India Pvt. Ltd, New Delhi.
- Rao V and Rao H. 1996. C++ Neural Networks and Fuzzy Logic. BPB Publications, New Delhi.

I. Course Title: Soft Computing Techniques in Engineering

II. Course Code: CSE 504

III. Credit Hours: 2+1

IV. Aim of the course

To learn the basic concepts of soft computing techniques like neural networks, genetic algorithms and fuzzy systems and apply these techniques for real time problem solving.

V. Theory

Unit I

Introduction to control techniques, need of intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule based systems, the artificial intelligence approach. Knowledge representation and expert systems. Data preprocessing: Scaling, Fourier transformation, principle component analysis and wavelet transformations.

Unit II

Concept of artificial neural networks (ANN) and basic mathematical model, network structures, activation function, back propagation, network size and pruning McCulloch-Pitts neuron model, simple perceptron, adaline and madaline neural networks, feed-forward multi-layer perceptron. Learning and training the neural network. Networks: Hopfield network, self-organizing network and recurrent network. Neural network based controller. Case studies: Identification and control of linear and nonlinear dynamic systems.

Unit III

Genetic algorithm (GA): Basic concept and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using GA. Concept of other search techniques like tabu search and ant-colony search for solving optimization problems.

VIII. Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	To work on data transformations, brief review on statistical criteria for termination of epochs, deciding the input output and hidden layers and neutrons for ANN problems,	3
2	Symbolic reasoning system, rule based systems, the artificial intelligence approach.	3
3	Symbolic reasoning system, rule based systems, the artificial intelligence approach.	2
4	Data pre-processing: Scaling, Fourier transformation, principle component analysis and wavelet transformations.	2
5	Concept of artificial neural networks (ANN) and basic mathematical model, network structures, activation function, back propagation, network size and pruning McCulloch-Pitts neuron model	3
6	Simple perceptron, adaline and madaline neural networks, feed-forward multi-layer perceptron. Learning and training the neural network.	3
7	Networks: Hopfield network, self-organizing network and recurrent network. Neural network based controller. Case studies:	3

	Identification and control of linear and nonlinear dynamic systems	
8	Genetic algorithm (GA): Basic concept and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using GA.	3
9	Concept of other search techniques like tabu search and ant-colony search for solving optimization problems.	2
10	Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning.	2
11	Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning.	2
12	Fuzzy knowledge and rule bases.	2
13	Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control.	2
14	Implementation of fuzzy logic controller. Stability analysis of fuzzy control systems.	2
15	Intelligent control for SISO/MIMO nonlinear systems. Model based multivariable fuzzy controller.	2
TOTAL		**36**

IX. List of Practicals

Sl. No.	Topic	No. of Practicals
1	To work on data transformations, brief review on statistical criteria for termination of epochs, deciding the input output and hidden layers and neutrons for ANN problems,	3
2	Working on different algorithms of ANN to different problems in agricultural engineering, working with different fuzzy relations,	2
3	propositions, implications and inferences, working with defuzzification techniques and fuzzy logic controllers, concept of coding	3
4	selection, crossover, mutation and application of genetic programming for global optimization, use of available software for application of soft computing techniques.	4
TOTAL		**12**

X. Suggested Reading

- David EG. Genetic Algorithms.
- Rajasekaran S and Vijayalakshmi Pai GA. 2017.Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications. PHI Learning Pvt. Ltd.
- Ross TJ. 1997. Fuzzy Logic with Fuzzy Applications. McGraw Hill Inc.
- Simon H. 2003. Neural Networks: A Comprehensive Foundation. Pearson Edition.

- Sivanandam SN and Deepa SN. 2011. Principles of Soft Computing. Wiley India Pvt. Ltd., 2nd Edition.
- Sivanandam SN and Deepa SN. 2013. Principles of Soft Computing. Wiley India.

I. Course Title: Digital Image Processing

II. Course Code: CSE 506

III. Credit Hours: 2+1

IV. Aim of the course

To give an overview of digital image processing including visual perception, image formation, spatial transformations, image enhancement, color image representation and processing, edge detection, image segmentation and morphological image processing.

V. Theory

Unit I

Digital image fundamentals, elements of visual perception, light and the electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between pixels, linear and nonlinear operations.

Unit II

Image enhancement in the spatial domain, basic gray level transformations, histogram processing, basics of spatial filtering, smoothing spatial filters, sharpening spatial filters.

Unit III

Color image processing, color fundamentals, color models, pseudo color image processing, basics of full-color image processing, color transformations, smoothing and sharpening, color segmentation.

Unit IV

Image segmentation, detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, segmentation by morphological watersheds.

Unit V

Morphological image processing, dilation and erosion, opening and closing, extensions to gray-scale images.

VI. Practical

To write program to read and display digital image, image processing program using point processing method, program for image arithmetic operations, program for image logical operations, program for histogram calculation and equalization, program for geometric transformation of image, understand various image noise models and to write programs for image restoration and to remove noise using spatial filters. Brief outline of image processing tools.

VII. Learning outcome

This course introduces digital image processing. It focuses on the theory and algorithms underlying a range of tasks including acquisition, formation, enhancement, segmentation and representation.

VIII. Lecture Schedule

Sl. No.	**Topic**	**No. of Lectures**
1	Introduction and Fundamentals, Motivation and Perspective, Applications, Components of Image Processing System,	3
2	Element of Visual Perception, A Simple Image Model	1
3	Sampling and Quantization.	2
4	Light and the electromagnetic spectrum, image sensing and acquisition	2
5	Basic relationships between pixels, linear and nonlinear operations	2
6	Image Enhancement in Spatial Domain	2
7	Introduction; Basic Gray Level Functions	2
8	Histogram Specification	2
9	Basics of spatial filtering, smoothing spatial filters, sharpening spatial filters	2
10	Color image processing, color fundamentals	1
11	Color models, pseudo color image processing	1
12	Color transformations, smoothing and sharpening, color segmentation.	2
13	Image segmentation, detection of discontinuities	1
14	Edge linking and boundary detection, thresholding, region-based segmentation	2
15	Segmentation by morphological watersheds	1
16	Morphological image processing, dilation and erosion	2
17	Opening and closing, extensions to gray-scale images	2
TOTAL		**30**

IX. List of Practical

Sl. No.	Topic	No. of Practicals
1	Display digital image, image processing program using point processing method, program for image arithmetic operations	3
2	Program for image arithmetic operations, image logical operations, histogram calculation and equalization	4
3	Program for geometric transformation of image, understand various image noise models	4
4	Programs for image restoration and to remove noise using spatial filters	4
5	Brief outline of image processing tools	1
TOTAL		**16**

X. Suggested Reading

- Jayaraman S, Esakkirajan S and Veerakumar T. Digital Image Processing. Tata McGraw Hill Publication.
- Rafael CG and Richard EW. Digital Image Processing. Third Edition, Pearson Education.
- Sridhar S. Digital Image Processing. Oxford University Press.

I. Course Title: Finite Element Methods

II. Course Code: MATH 501

III. Credit Hours: 2+1

IV. Theory

Unit I

Introduction. Historical background, Stress equilibrium, boundary condition, stress strain relation, potential energy and equilibrium. Rayleigh-Ritz method. Galerkin method.

Unit II

coordinates and shape functions, potential energy approach, element stiffness matrix, Galerkin approach, assembly of global stiffness matrix. The finite element equation, boundary conditions.

Unit III

Trusses: Two dimensional problems, modeling by constant strain triangle, two dimensional iso-parametric elements, the four-node quadrilateral.

Unit IV

Scalar field problems, steady state heat transfer, torsion, potential flow, seepage and fluid flow index, dynamic analysis, principles.

V. Practical

Use of simple FEM software for FEM software for understanding, principles of FEM. Working out simple problems using LISA or any simple software with understanding of operation. Solving one dimensional problem. Solution to planar and spatial trusses, solving simple two-dimensional problems, Axisymmetric problems, solution of problems with two dimensional iso-parametric elements, solving simple beams and frames, three dimensional problems, solution to heat transfer problems and flow problems.

Learning outcome: Ability to formulate problems based on use of FEM and solve them using software tools.

VI. Lecture Schedule

Sl. No.	**Topic**	**No. of Lectures**
1	Introduction. Historical background, Stress equilibrium, boundary condition	4
2	Stress strain relation, potential energy and equilibrium, RayleighRitz method, Galerkin method.	4
3	coordinates and shape functions, potential energy approach, element stiffness matrix	3
4	Galerkin approach, assembly of global stiffness matrix, The finite element equation, boundary condition	3
5	Trusses: Two dimensional problems,	3
6	Trusses: Two dimensional problems,	3
7	Trusses: Two dimensional problems,	3
8	Scalar field problems, steady state heat transfer	3
9	Scalar field problems, steady state heat transfer	3
10	Scalar field problems, steady state heat transfer	3
TOTAL		32

VII. List of Practicals

Sl. No.	**Topic**	**No. of Practicals**
1	Use of simple FEM software for FEM software for understanding, principles of FEM.	3
2	Working out simple problems using LISA or any simple software with understanding of operation	3
3	Solving one dimensional problem, Solution to planar and spatial trusses	2

4	Solving simple two-dimensional problems, Axisymmetric problems	2
5	Solution of problems with two dimensional iso-parametric elements	2
6	Solving simple beams and frames	2
7	Three dimensional problems, solution to heat transfer problems and flow problems.	2
TOTAL		**16**

VIII. Suggested Reading

- Tirupathi R, Patla C and Belegundu AD. 1999. Introduction to Finite Element in Engineering. Prentice Hall of India Pvt. Ltd, New Delhi
- Singiresu RaoS. 2001. The Finite Element Method in Engineering. Butter worth Heinemann, New Delhi.
- Rajasekaran S 1999. Finite Element Analysis in Engineering Design. Wheeler Publishing, Division of A.h.Wheeler and Co. Ltd, Allahabad.
- Tutorials and Reference Guide, LISA Finite Element Analysis Software Version 8.0.0 2013

I. Course Title: Numerical Methods for Engineers

II. Course Code: MATH 502

III. Credit Hours: 2+1

IV. Aim of the course

To expose students to various numerical methods for solving algebraic equations, ordinary and partial differential equations.

V. Theory

Unit I

Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using bisection, false position, iteration, Newton Raphson, Secant methods. Solution of linear simultaneous equations: Matrix inversion, Gauss elimination, Gauss Jordan, LU decomposition methods, Gauss Jacob; Gauss Seidel.

Unit II

Solution of Ordinary Differential Equations: Initial Value Problem, Taylor series method, Picard's method, Euler method, Modified Euler method, RK class and predictor corrector class methods. Stiff ODE's and Gear's methods. Boundary Value Problem, Shooting methods, finite difference method.

Unit III

Eigen values and Eigen vectors: Maximum and minimum eigenvalue by Power spectral and Inverse Power Method, all eigenvalues. Introduction to diagonalization and QR Factorization. Approximation Theory.

Unit IV

Finite difference formulae: Forward and backward differences, Richardson's extrapolation, interpolation formulae, polynomial forms, linear interpolation, Lagrange interpolation polynomial, Newton interpolation polynomial.

Unit V

Solution of Partial Differential Equations: Classification of PDEs(Parabolic, elliptical and hyperbolic equation), Elliptical equations, standard five pointsformula, diagonal five-point formula. Solution of Laplace equation by Liebman's iteration method. Poisson's equation and its applications, Crank-Nicholson difference method.

VI. Tutorial

Use of EXCEL Sheet and MATLAB: Application of EXCEL Sheet and MATLAB to solve the Engineering problems

VII. Learning outcome

Ability to solve algebraic equations, ordinary and partial differential equations coming across in Agricultural Engineering problems using various numerical methods, ability to use latest software's towards numerical problems.

VIII. Lecture Schedule

Sl. No.	**Topic**	**No. of Lectures**
1	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using bisection method.	2
2	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using false position methods.	1
3	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using iteration.	1
4	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using Newton Raphson, Secant methods.	1

5	Solution of linear simultaneous equations: Matrix inversion, Gauss elimination, Gauss Jordan method.	2
6	Solution of linear simultaneous equations: LU decomposition methods, Gauss Jacob; Gauss Seidel.	2
7	Solution of Ordinary Differential Equations: Initial Value Problem, Taylor series method, Picard's method, Euler method, Modified Euler method	2
8	Solution of Ordinary Differential Equations: RK class and predictor corrector class methods. Stiff ODE's and Gear's methods.	1
9	Eigen values and Eigen vectors: Maximum and minimum eigenvalue by Power spectral and Inverse Power Method.	2
10	Eigen values and Eigen vectors: all eigenvalues by Fadeev-Leverrier method	2
11	Introduction to diagonalization and QR Factorization. Approximation Theory.	2
12	Finite difference formulae: Forward and backward differences, Richardson's extrapolation, interpolation formulae, polynomial forms.	2
13	Finite difference formulae: linear interpolation, Lagrange interpolation polynomial, Newton interpolation polynomial.	2
14	Solution of Partial Differential Equations: Classification of PDEs (Parabolic, elliptical and hyperbolic equation)	2
15	Elliptical equations, standard five pointsformula, diagonal five-point formula.	2
16	Solution of Laplace equation by Liebman's iteration method. Poisson's equation and its applications.	2
17	Solution of parabolic equations by Bender–Schmidt method	2
18	Solution of parabolic equations by Bender-Schmidt recurrence equation, Crank-Nicholson difference method.	2
TOTAL		**32**

IX. List of Tutorials

Sl. No.	**Topic**	**No. of Tutorials**
1	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using bisection method.	1
2	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using false position methods.	1
3	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using iteration.	1
4	Solution of Algebraic Equations: Solution of non-linear and transcendental equations in one or more than one variable using Newton Raphson, Secant methods.	1

5	Solution of linear simultaneous equations: Matrix inversion, Gauss elimination, Gauss Jordan method.	1
6	Solution of linear simultaneous equations: LU decomposition methods, Gauss Jacob; Gauss Seidel.	1
7	Solution of Ordinary Differential Equations: Initial Value Problem, Taylor series method, Picard's method, Euler method, Modified Euler method	1
8	Solution of Ordinary Differential Equations: RK class and predictor corrector class methods. Stiff ODE's and Gear's methods.	1
9	Eigen values and Eigen vectors: all eigenvalues by Fadeev-Leverrier method	1
10	Eigen values and Eigen vectors: all eigenvalues by Fadeev-Leverrier method	1
11	Introduction to diagonalization and QR Factorization. Approximation Theory.	1
12	Solution of Partial Differential Equations: Classification of PDEs (Parabolic, elliptical and hyperbolic equation), Elliptical equations, standard five points formula, diagonal five-point formula.	1
13	Solution of Partial Differential Equations: Classification of PDEs (Parabolic, elliptical and hyperbolic equation), Elliptical equations, standard five points formula, diagonal five-point formula.	1
14	Solution of Partial Differential Equations: Classification of PDEs (Parabolic, elliptical and hyperbolic equation), Elliptical equations, standard five points formula, diagonal five-point formula.	1
15	Solution of Laplace equation by Liebman's iteration method. Poisson's equation and its applications.	1
16	Solution of parabolic equations Crank-Nicholson difference method	1
TOTAL		**16**

X. Suggested Reading

- Anderson T W 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.
- Dillon W R and Goldstein M. 1984. Multivariate Analysis - Methods and Applications. John Wiley.
- Electronic Statistics Text Book: http://www.statsoft.com/textbook/stathome.html
- Goon A M, Gupta M K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
- Goon A M, Gupta M K and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
- Hoel P G. 1971. Introduction to Mathematical Statistics. John Wiley.
- Hogg R V and Craig T T. 1978. Introduction to Mathematical Statistics. Macmillan.
- Montgomery and Runger 2014. Applied Statistics and Probability for Engineers. John Wiley

- Morrison D F. 1976. Multivariate Statistical Methods. McGraw Hill.
- Siegel S, Johan N and Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.

I. Course Title : Dimensional Analysis and Similitude

II. Course Code : ASCE 501

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students with importance of analysis of dimensions and similitude principles instructoring mathematical/simulation models of various processes under different constraint variables.

V. Theory

Unit I

Introduction, Dimensions, Dimensional homogeneity, Non-dimensional parameter, Methods of dimensional analysis: Rayleigh's method, Buckingham-Pitheorem, Choice of variables, Model analysis, Examples on various applications, Dimensional analysis and Intermediate Asymptotic.

Unit II

Model studies, Model classification, Dimensionless numbers: Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, Scale effects, Distorted models, Model laws.

Unit III

Similitude: Types of similarities (geometric-kinematic and dynamic similarity), force ratios, similarity laws. Model analysis: Physical models. Similarity methods for nonlinear problem types of models, Scale effect. Numerical problems on Reynolds's and Froude's Model.

Unit IV

Use and scope of mathematical modeling, Principles of model formulation, Role and importance of steady-state and dynamic simulation, Classification of models, Model building, Modeling difficulties, Degree-of-freedom analysis, Selection of design variables.

VI. Learning outcome

The students will be able to analyze complex problems using dimensional analysis and to develop rules for experiments with scale models and provide basis for analyses and calculations, including simplifications and assumptions made, when formulating mathematical models.

VII. Lecture Schedule

S. No.	Topic	No. of Lectures
1.	Introduction, Dimensions, Dimensional homogeneity, Non-dimensional parameter	2
2.	Methods of dimensional analysis: Rayleigh's method, Buckingham- Pitheorem, Choiceofvariables	3
3.	Model analysis, Examples on various applications, Dimensional analysis and Intermediate Asymptotic	2
4.	Model studies, Model classification, Dimensionless numbers: Reynolds model	3
5.	Froude's model, Euler's Model, Webber's model, Mach model	
6.	Distorted models, Model laws.	2
7.	Similitude: Types of similarities (geometric-kinematic and dynamic	3
8.	similarity),forceratios, similarity laws Model analysis: Physical models. Similarity methods for nonlinear problemtypesof models, Scaleeffect	3
9.	Numerical problems on Reynolds's and Froude's Model	3
10.	Use and scope of mathematical modeling, Principles of model formulation	2
9.	Numerical problems on Reynolds's and Froude's Model	3
10.	Use and scope of mathematical modeling ,Principles of model formulation	2
11.	Role and importance of steady-state and dynamic simulation	2
12.	Classification of models, Model building, Modeling difficulties	2

13.	Degree-of-freedom analysis, Selection of design variables	2
	Total	32

VIII. Practical Schedule

S. No.	Topic	No. of Practicals
1	Dimensional analysis: Rayleigh's method and Buckingham- Pi	3
2	Dimensional analysis: Matrix method	2
3	Model analysis: Froude's model, Euler's Model, Webber's model, Mach model	5
4	Equations for the period of simple pendulum. Uniform rectangular cantilever beam. Spring mass level system. Investigation of extrapolation	3
5	Deflection of a cantilever beam. Prediction of the deflection of a beam using a model. Analogue model experiments	3
	Total	16

IX. Suggested reading

- Modi, P.N and Seth, 22nd edition, S.M, Hydraulics and Fluid Mechanics
- Barenblatt GI.1987. Dimensional Analysis. Gordona nd Breach Science, NewYork.
- LangharHL.1951. Dimensional Analysis and the Theory of Models. Wiley, NewYork.
- MurphyG.1950. Similitude in Engineering. The Ronald Press Company, NewYork.
- Zohuri Bahman. Dimensional Analysis and Self-Similarity Methods for Engineers and Scientists. Springer Publications, NewYork.

I. Course Title: Water Quality and Pollution Control

II. Course Code: ASCE 502

III. Credit Hours: 2+1

IV. Aim of the course

To acquire in-depth knowledge of water quality parameters, water quality standards, source of water pollution and multiple use of water.

V. Theory

Unit I

Physical and chemical properties of water, suspended and dissolved solids, EC and pH, major ions. Water quality (Physical, Chemical and Bacteriological) investigation, Sampling design, Samplers and automatic samplers. Data collection platforms, Field kits, Water quality data storage, analysis and inference, Software packages. Water quality indices. Water quality for irrigation. Salinity and permeability problem, saline water irrigation root zone salinity, interaction of irrigation and drainage.

Unit II

Sources and types of pollution, organic and inorganic pollutants. BOD–DO relationships, impacts on water resources. NPS pollution and its control, Eutrophication control. Water treatment technologies, Constructed wetlands.

Unit III

Multiple uses of water. Reuse of water in agriculture. Low cost waste water treatment technologies Economic and social dimensions. Packaged treatment units, soil-based water treatment methods, reverse osmosis and desalination in water reclamation.

Unit IV

Principles of water quality, water quality classification, water quality standards, water quality indices, TMDL Concepts. Water quality models. Soil crop and other practices for use of poor quality water.

VI. Practical

Determination of pH, total solids, dissolved and suspended solids, chlorides, sulphates, turbidity, dissolved oxygen, hardness. Preparation of water quality map of watershed in GIS environment. Visit of water polluted site of nearby area.

VII. Learning outcome

The students will be able to understand water quality standards which are quite important for drinking and irrigation purposes. They will also be exposed to source and type of pollution along with multiple uses of water.

VIII. Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	Physical and chemical properties of water, suspended and dissolved	3

	solids, EC and pH, major ions. Water quality (Physical, Chemical and Bacteriological) investigation	
2	Sampling design, Samplers and automatic samplers. Data collection platforms, Field kits, Water quality data storage, analysis and inference	3
3	Software packages. Water quality indices. Water quality for irrigation	2
4	Salinity and permeability problem, saline water irrigation root zone salinity, interaction of irrigation and drainage	3
5	Sources and types of pollution, organic and inorganic pollutants. BOD–DO relationships, impacts on water resources	3
6	NPS pollution and its control, Eutrophication control. Water treatment technologies, Constructed wetlands	3
7	Multiple uses of water. Reuse of water in agriculture. Low cost waste water treatment technologies	3
8	Economic and social dimensions. Packaged treatment units, soil-based water treatment methods, reverse osmosis and desalination in water reclamation	3
9	Principles of water quality, water quality classification	3
10	water quality standards, water quality indices	2
11	TMDL Concepts. Water quality models	2
12	Soil crop and other practices for use of poor quality water	2
TOTAL		**32**

IX. List of Practicals

Sl. No.	Topic	No. of Practicals
1	Determination of pH, total solids, dissolved and suspended solids	4
2	Determination of chlorides, sulphates, turbidity	3
3	Determination of chlorides, sulphates, turbidity	4
4	Preparation of water quality map of watershed in GIS environment	4
5	Visit of water polluted site of nearby area	1
TOTAL		**16**

X. Suggested Reading

- Abbasi T and Abbasi SA. Water Quality Indices. Elsevier Publications, New York.
- Chin and David A. 2006. Water Quality Engineering in Natural Systems. Wiley – Interscience.
- Claude E. Boyd. Water Quality an Introduction. Springer Publications.
- Eaton AD, Clesceri LS, Rice EW and Greenburg AE (eds). 2005. Standard Methods for the Examination of Water and Wastewater. 21st edn. American Public Health Association, Washington, DC.
- Thomann RV and Mueller JA. 1987. Principles of Surface Water Quality Modelling and Control. Harper and Row Publishers.

- Wesley W, Wallender PE and Kenneth K. Tanji, Sc.D. Agricultural Salinity Assessment and Management. ASCE Press.

ENVIRONMENTAL ENGINEERING FOR PLANTS AND ANIMALS

1. Course No : ASCE 601
2. Course title : Environmental Engineering for plants and animals
3. Credit hours : 3(3+0)
4. Class : 2nd Year M.Tech/ 1st Yr. Ph.D
5. Semester : 1st semester
6. General Objective : To educate the students in different environmental engineering aspects for plants and animals
7. Specific Objectives :

    1. Understand different aspects of aerial environment and energy interaction with atmosphere
    2. Gather knowledge about various solute transport processes in soil
    3. Acquaint themselves with various environmental damages associated with agriculture sector
    4. Learn about various aspects of environment friendly animal husbandry and crop management
    5. Design of efficient environmental control mechanisms and systems to enhance crop productivity

Theory

UNIT-I

Description of aerial environment near earth's surface

UNIT-II

Transportation processes in soil: environmental interactions of biological systems and their physical surroundings emphasizing biological response of animals and plants

UNIT-III

Environmental damages associated with agriculture, Crop management in favourable environment.Intensive system of agriculture, tillage practices, planting, fertiliser application and use of machinery, hi-tech farming impact on environment, modern farming vs organic farming

UNIT-IV

Livestock management, poultry, dairy, piggery, safe rearing, housing, impact on environment. Decline of soil fertility, nutrient loss, pollution of surface and ground water, use of chemicals in soil, soil erosion, loss of organic matter, compaction, salinization, desertification, eutrophication, emission of GHGs, soil fertility, pest management etc.

UNIT-V

Design of efficient environmental control machines and systems to enhance productivity and health, Environmental control for agricultural buildings

Lecture Outline

Lecture	Chapter	Details
1	Aerial environment	Atmosphere & its composition
2		Stratification
3		Study of different layers, exosphere, thermosphere, mesosphere, stratosphere, troposphere and other layers
4	Atmosphere	Different properties of the atmosphere
5		Energy interaction 8 different laws
6	Radiation	Electromagnetic radiation and its effect on animals and plants
7		Soil and air temperature, wind movement, evaporation and photosynthesis
8	Transportation process in soil	Solute transport in soil. Convection, molecular diffusion, mechanical dispersion
9		Interactions of organisms in an ecosystem
10		Pollination and predation
11		Symbiosis
12	Ecosystems	Ecosystems and interactions among living organisms
13		Producers, consumers and decomposers
14		Movement of matter and energy
15	Interaction	Biological interaction among unicellular and multi cellular micro-organisms
16	Agricultural pollution	Environmental damages due to agriculture
17		Tillage, fertiliser application
18		Climate change, deforestation
19		Bio-diversity
20		Irrigation , drainage & leaching problems
21		Soil degradation
22		Smart/Precision farming
23		Benefit of organic farming and comparison with organic farming

24	Livestock Management	Animal husbandry & its effects
25		Favourable climatic conditions for domestic animals & birds
26		Establishment of dairy units
27		Open barns, stall barns
28		Requirement of modern dairy units
29		Environment control for animals & birds
30		Development of modern poultry units
31		Different poultry houses and their environment control
32		Piggery units and rearing/housing
33	Environmental Engineering for plants/crops	Causes of loss of soil fertility
34-35		Pollution of surface and ground water & remedial measures
36		Use of pesticides and harmful effects on plants and animals
37-38		Soil erosion & types
39		Desertification, causes & remedial measures
40		Salinization & its effect
41		Eutrophication, causes & measures to control
42		GHG emissions and prevention
43	Efficient environmental machines and systems	Environmental control in green houses for crop production
44		Environmental control in milking parlour
45		Effect of light, temp.,CO2 and RH for plant growth
46	Environmental control for agricultural buildings	Types of Agricultural buildings for crop production & production
47-48		Environmental control in various Agricultural buildings

Suggested Readings

Albright L.D.1990. Environmental Control for Animals and Plants, ASAE Text Books

Esmay, M.L. and Dixon, J.E.1986.Environmental Control for Agricultural Buildings-The AVI Corp.

Gaudy, A.F. and Gaudy, E.T.1988.Elements of Environmental Engineering, Engineering Press

Moore, F.F.1994.Environmental Control Systems, Heating, Cooling, Lighting, Chappman and Hall
Threlkeld, J.L.1970, Thermal Environmental Engineering, Prentice Hall
Pandey, P.H.2004.Principles of Agricultural Structures and Environmental Control, Kalyani Publishers, Ludhiana
Nathonson, J.A. Basic Environmental Technology, Prentice Hall of India
Banerjee, G.C. A Text Book of Animal Husbandry, Oxford IBH Pub. Co. New Delhi

APPLIED INSTRUMENTATION EE-501 2+1

Theory

UNIT I

Basic instrumentation systems. Transducers principles. Active and passive transducers, analog and digital transducers, Displacement transducers, Potential meters, LDVT, Piezoelectric and capacitive transducers, velocity transducers. Strain gauges, types and applications. Performance characteristics of instruments including static and dynamic characteristics. Power and energy measuring technique

UNIT II

Temperature measurement using bi-metals, thermistors, thermocouples, humidity measurement, manometers. Need for digital instruments, Advantages and requirements of digital instruments, Measurement of frequency, Ratio of two frequencies, Product of two frequencies, high, average and low-frequency measurement, Digital Tachometer.

UNIT III

Load cells, torque meters, flow meters' types and principles of working. Measurement of recording devices and their types. Measuring instruments for calorific value of solid, liquid, and gaseous fuels.

UNIT IV

Basic signal conditioning devices - data acquisition system - micro computers for measurement and data acquisition. Data storage and their application including wireless communication. Function Generator, Pulse Generator, RF Signal Generator, Harmonic Distortion Analyzer, Spectrum Analyzer, Digital Storage CROs.

Practical

Experiment on resistive, inductive and capacitive transducer.

Experiment on LVDT and strain gauge transducer.

Speed measurement using optical devices.

Vibration measurement exercises.

Study of block wise construction of a Function Generator

Measure of Voltage, Frequency, Phase and Modulation Index (Trapezoidal Method) using CRO

Demonstrate features of Digital Storage Oscilloscope

Simulation of digital clock using Matlab

Addition and product of different frequencies using Matlab

Simulation of digital voltmeter using Matlab.
Analysis and simulation of digital multi-meter.

Suggested Readings

David A. Bell - Electronic Instrumentation and Measurements, Oxford Univ. Press, 1997
Mechanical Measurements. Addison-Wesley. Doeblin EO. 1966.
Measurement System - Application and Design.McGraw Hill. Ernest O Doebelin.1995.

Instrumentation and Control. Fundamentals and Application. John Wiley & Sons. Oliver FJ. 1971.

Applied Instrumentation

Course No. : EE-501 **Credit Hours** : 3(2+1)

(A)Theory lecture outlines:

Lecturer	Chapter	Detail
1	**UNIT-I**	Basic instrumentation systems introduction.
2		Transducers principles and types.
3		Active and passive transducers with application
4		Analog and digital transducers with application,
5		Displacement transducers.
6		Piezoelectric and capacitive transducers.
7		Velocity transducers circuit.
8		Potential meters and LDVT
9		Strain gauges, types and applications.
10		Performance characteristics of instruments including static and dynamic characteristics.
11		Power and energy measuring technique
12	**UNIT-II**	Basic Temperature measurement instruments and types.
13		Measurement of temperature using bi-metals.
14		Measurement of temperature using thermisters and thermocouples.
15		Humidity measurement, manometers.

16		Need for digital instruments, Advantages and requirements of digital instruments.
17		Measurement of frequency, Ratio of two frequencies.
18		Product of two frequencies, high, average and low-frequency measurement.
19		Digital Tachometer.
20	**UNIT-III**	Load cells types and principles of working.
21		torque meters, and flow meters' types and principles of working.
22		Measurement of recording devices and their types.
23		Measuring instruments for calorific value of solid, liquid, and gaseous fuels.
23	**UNIT-IV**	Basic signal conditioning devices.
24		Data acquisition system and application
25		Micro computers for measurement and data acquisition.
26		Data storage and their application including wireless communication.
27		Function Generator and application
28		Pulse Generator with application
29		RF Signal Generator with application
30		Harmonic Distortion Analyzer,
31		Spectrum Analyzer
32		Digital Storage CROs.

(B) Practical Class Outline:

Class	**Topics to be covered**
1	Experiment on resistive, inductive and capacitive transducer.
2	Experiment on LVDT.
3	Experiment on strain gauge transducer.

4	Speed measurement using optical devices and tachometer.
5	Experiment on thermistor for temperature measurement
6	Experiment on thermocouple
7	Vibration measurement exercises.
8	Measurement of Voltage and Frequency using CRO.
9	Measurement of Phase and Modulation Index (Trapezoidal Method) using CRO Demonstrate features of Digital Storage Oscilloscope
10	Study of block wise construction of a Function Generator
11	Study of block wise construction of a DSO.
12	Simulation of digital clock using Matlab
13	Addition and product of different frequencies using Matlab
14	Simulation of digital voltmeter using Matlab.
15	Analysis and simulation of digital multi-meter.
16	Experiment on resistive, inductive and capacitive transducer.

Suggested readings:

David A. Bell - Electronic Instrumentation and Measurements, Oxford Univ. Press, 1997
Mechanical Measurements. Addison-Wesley. Doeblin EO. 1966.

Shaney A. K. 1997.*Measurement of Electrical and Electronic Instrumentation*. Khanna Publications.

Measurement System - Application and Design.McGraw Hill. Ernest O Doebelin.1995.

Instrumentation and Control. Fundamentals and Application. John Wiley & Sons. Oliver FJ. 1971.

I. Course Title: Statistical Methods for Research Workers

II. Course Code: STAT 501

III. Credit Hours: 2+1

IV. Aim of the course

To expose students to various statistical techniques for analysis of data and interpretation of results.

V. Theory

Unit I

Probability and probability distributions. Principle of least squares. Linear and non-linear regression. Multiple regression. Correlation analysis. Selection of variables. Validation of models. Sampling techniques. Determination of sample size. Sampling distribution of mean and proportion.

Unit II

Hypothesis testing. Concept of p-value. Student's t-test. Large sample tests. Confidence intervals. ANOVA and testing of hypothesis in regression analysis. Analysis of variance for one way and two way classification (with equal cell frequency).Transformation of data.

Unit III

Advantages and disadvantages of nonparametric statistical tests. Scales of measurements. Run-test. Sign test. Median test. Wilcoxon-Mann Whitney test. Chi-square test. Kruskal-Walli's one way and Friedman's two way ANOVA by ranks. Kendall's Coefficient of concordance.

VI. Practical

Fitting of distributions. Sample and sampling distributions. Correlation analysis. Regression analysis (Multivariate, quadratic, exponential, power function, selection of variables, validation of models, ANOVA and testing of hypothesis). Tests of significance (Z-test, t-test, F-test and Chi-square test). Analysis of variance. Nonparametric tests.

VII. Learning outcome

The students will be able to understand different techniques for analyzing the data of their research work.

VIII. Lecture Schedule

Sl. No.	**Topic**	**No. of Persons**
1	Elementary statistics	
2	Probability theory	2
3	Probability distributions (Binomial, Poisson and Normal)	3
4	Sampling techniques, Determination of sample size	2
5	Sampling distribution of mean and Proportion	1
6	Hypothesis testing concept of p-value	1

7	Large sample (mean, proportion)	1
8	Student's t-test (Single mean, Difference of mean for independent samples and paired observations) and F-test	3
9	Analysis of variance (one way and two way), Transformation of data	2
10	Correlation analysis and testing (Bivariate, Rank, Intra-class, Partial, Fisher's Z-transformation) 2	2
11	Multiple linear regression and model validation	2
12	Testing of coefficient of determination and regression coefficient	2
13	Selection of variables in regression (forward substitution method and step-wise regression)	1
14	Non-Linear regression (Quadratic, exponential and Power)	2
15	Introduction to Non-parametric and scales of measurements	1
16	Chi-square test (Goodness of fit, Independence of attributes, homogeneity of variances)	2
17	One Sample test (Sign test, Median test, Run rest,)	2
18	Two sample test (Wilcoxon Sign test, Mann Whitney test, Chi square test for two independent samples)	1
19	K-Sample (Kruskal-Walli's test and Friedman's two way ANOVA)	2
20	Kendall's coefficient of concordance	1
TOTAL		33

IX. List of Practicals

Sl. No.	**Topic**	**No. of Practicals**
1	Probability distributions (Binomial, Poisson and Normal)	1
2	Probability distributions (Binomial, Poisson and Normal)	1
3	Sampling techniques, Determination of sample size, Sampling distribution of mean and Proportion	1
4	Large sample (mean, proportion)	1
5	Analysis of variance (one way and two way), Transformation of data	1
6	Analysis of variance (one way and two way), Transformation of data	2
7	Non-Linear regression (Quadratic, exponential and Power)	1
8	Non-Linear regression (Quadratic, exponential and Power)	1
9	Non-Linear regression (Quadratic, exponential and Power)	
10	Non-Linear regression (Quadratic, exponential and Power)	1
11	Non-Linear regression (Quadratic, exponential and Power)	2
12	Introduction to Non-parametric and scales of measurements	
13	Chi-square test (Goodness of fit, Independence of attributes, homogeneity of variances)	2
14	One Sample test:Sign test, Median test, Run rest, Two sample test: Wilcoxon Sign test, Mann Whitney test, X2 test for two independent	1

	samples	
15	K-Sample: Kruskal-Walli's test and Friedman's two way ANOVA, Kendall's coefficient of concordance	1
TOTAL		**16**

X. Suggested Reading

- Anderson T W 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.
- Dillon W R and Goldstein M. 1984. Multivariate Analysis - Methods and Applications. John Wiley.
- Electronic Statistics Text Book: http://www.statsoft.com/textbook/stathome.html
- Goon A M, Gupta M K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
- Goon A M, Gupta M K and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
- Hoel P G. 1971. Introduction to Mathematical Statistics. John Wiley.
- Hogg R V and Craig T T. 1978. Introduction to Mathematical Statistics. Macmillan.
- Montgomery and Runger 2014. Applied Statistics and Probability for Engineers. John Wiley
- Morrison D F. 1976. Multivariate Statistical Methods. McGraw Hill.
- Siegel S, Johan N and Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley