

MODEL CURRICULUM
FOR
UNDERGRADUATE PROGRAMME
B.E/B. TECH.
IN
AGRICULTURE ENGINEERING



All India Council for Technical Education

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PREFACE

The need to ensure minimum acceptable standards and quality in curricula of Engineering Colleges spread across the country and recent technological advances have necessitated development of Model Curriculum for various disciplines of first degree course in Engineering by All India Council for Technical Education. The planning of engineering curricula is a complex exercise since it involves integration of not only the current educational needs of the profession but also the anticipated needs arising out of the fast changing national and international technological scene. To make the curricula both dynamic, to meet the evolving needs of the profession and flexible to adjust to unforeseen developments, the first step is to identify the core part of the curriculum which embodies scientific and engineering knowledge basic to the profession. To this core is added, in different proportions, the other ingredients of professional knowledge of both current and emerging technological processes and systems. With a proper balancing of the core, specialised and elective subjects and suitable integration of meaningful practical and field exercises and challenging project activity, the curriculum can, not only provide the students with relevant professional knowledge, but also develop in them the capacity to tackle unknown engineering problems and help them acquire sound professional ethics and an awareness of their obligations to society.

In 1996 the AICTE initiated a program to upgrade the syllabi for undergraduate education in technical institutions in India. An exercise to develop detailed curricula which will serve as a model for the institutions was taken up. The emergence, on the national scene, of several new engineering colleges added a sense of urgency to this effort. Since QIP Centres were already intimately involved with the curriculum development activities sponsored by AICTE, they were requested to undertake this important task.

I am glad that Model Curricula for various disciplines which are both dynamic and flexible and provide a proper balance in the teaching of basic sciences, social sciences and management, engineering sciences, technologies and their applications have been finalised. I am sure that this work will serve as a useful guide to the universities and institutions in framing their curricula.

I take this opportunity to express my deep appreciation for the valuable work done by the various members of the Expert Committees and the persons entrusted with the responsibility of co-ordinating the work in the respective disciplines.

Chairman

All India Council for Technical Education

INTRODUCTION

All India Council for Technical Education (AICTE) has been entrusted with the responsibility of co-ordinated development of technical education system throughout the country. Uniform form growth of technical education requires continuous up-gradation of Curricula for courses at all levels in Technical Education. This need is further accentuated by the emergence of a large number of self-financing institutions in technical education where faculty does not have sufficient expertise. In pursuance of clause 10(1) of AICTE Act and with an objective of bringing about uniformity in the curriculum of Engineering, AICTE has initiated a programme to come up with the syllabi for undergraduate education in technical institutions.

The broad strategies for framing the curricula included the study and analysis of the existing curricula followed in various institutions within the country and also the feedback received in various workshops involving faculty from different institutions. The draft Model Curriculum was discussed in a wide forum before coming up with the present version.

Based on the interaction and discussion with a number of experts the following recommendations were finalised.

- The duration of a degree level course should be limited to 4 years/ 8 semesters of about 90 working days each.
- A common first year syllabus with sufficient emphasis on Hum. & Science and Management subjects shall be adopted for all branches of engineering.
- The contact hours per week should normally be kept at about 30 hours.
- Weightage of 15-20% shall be given to non-professional (Basic Sciences and Humanities) subjects and about 10% to Management subjects.
- Normally the curriculum should include a Major Project of minimum 8 credits in Final Year (2 credits in 7th semester and 6 credits in 8th semester). Emphasis should be given to industry sponsored projects.
- Wherever possible the students in 3rd & 4th year should be involved in group discussions on topics of current trends in Engineering & Technology. (No credit)
- There should be a continuous evaluation system. Various components of evaluation suggested are Teachers Assessment (TA), Class Tests (CT) also called minors in some of the institutions and End Semester Examination (ESE). To make the evaluation more objective, teachers assessment could be broken into various components like assignments, quizzes, attendance, group discussions. Tutorials etc. Similarly marks of class Tests can be awarded by having at least two to three tests. These two components i.e. T A & CT put together would form the sessional components. End Semester Examination will have to be conducted by the Institute through concerned affiliating University, as per its regulations.

- On the basis of total marks (TA +CT +ESE) in each subject obtained, a letter grade should be awarded where A = 10, B = 8, C = 6, D = 4, F = 0. Normally top 5 - 10% should be awarded 'A' Grade and last 5-10% 'F' Grade.

In order to evaluate grade point average for a semester the same could be done using the following illustration:

Subjects	L	T	P	Credit = { L + (T +P)/2}	Grade Awarded
I	2	1	0	3	A
II	3	1	2	5	B
III	3	1	0	4	A
IV	3	1	0	4	B
V	0	0	3	2	C

$$\begin{aligned} \text{Semester Grade Point Average} &= \frac{3A + 5B + 4A + 4B + 2C}{3+5+4+4+2} \\ &= (30+40+40+32+ 12)/18 = 8.55 \end{aligned}$$

L Lecture

T : Tutorial

P : Practical

- In order to meet the demand of changing trends and emerging areas a student be given a choice to choose subjects offered as electives which consist of a professional elective (PE) of 12' Credits and an open elective (non departmental elective) of 8' Credits.
- Based on the recommendations a Model Curriculum has been framed. A model structure of the total courses to be undertaken by a student during his undergraduate programme in Agriculture Engineering is shown in the subsequent tables. The institute may assign the course numbers depending upon the guidelines of the respective affiliating university.

This developmental exercise is underpinned by the philosophy that curriculum should transcend traditional instructional modes, embrace novel methods of teaching and enhance and embellish the learning process to produce quality engineers for the future. The success of the curriculum lies in its implementation. It is suggested that advantage be taken of modern technology by augmenting the role of a teacher with innovative audio-visual and digital teaching and learning aids. This curriculum is only a base line and institutions

should aspire to develop over and above this. The development of this model curriculum has been possible only through the sustained and dedicated efforts of a large number of faculty members from various institutions. The AICTE expresses its gratitude *to* them for contributing their time and expertise in this important national task. Suggestions to improve the quality of contents of this curriculum will be highly appreciated.

(Prof. R.S. Nirjar)

Member Secretary

All India Council for Technical Education

COURSE STRUCTURE

BRANCH: Agriculture Engineering**YEAR : I****SEMESTER: I****(Common to all branches)**

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Language (professional Comm. in English)	2	1	-	15	10	25	50	75	3
2.		Engineering Chemistry	2	1	-	15	10	25	50	75	3
3.		Engineering Physics I	3	1	-	30	20	50	100	150	4
4.		Mathematics I	3	1	-	30	20	50	100	150	4
5		Engineering Mechanics	3	1	-	30	20	50	100	150	4
6.		Basic Electrical Engineering	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Chemistry/Physics Lab. (To be taken in alternate weeks)	-	-	3	25	-	25	25	50	2
8.		Engineering Mechanics/ Electrical Laboratory	-	-	3	25	-	25	25	50	2
9.		Engineering Graphic I	-	-	3	25	-	25	25	50	2
10.		Workshop Practice – I	-	-	3	25	-	25	25	50	2
	GP-I	GENERAL PROFICIENCY						50	-	50	2
		Total	16	6	12					1000	32

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000,

Total Periods: 34, Total Credits: 32

BRANCH: Agriculture Engineering**YEAR : I****SEMESTER: II****(Common to all branches)**

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Introduction to Computing	2	1	-	15	10	25	50	75	3
2.		Environment and Ecology	2	1	-	15	10	25	50	75	3
3.		Engineering Physics II	3	1	-	30	20	50	100	150	4
4.		Mathematics II	3	1	-	30	20	50	100	150	4
5		Engineering Thermodynamics	3	1	-	30	20	50	100	150	4
6.		Basic Electronics	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Basic Electronics Lab.	-	-	3	25	-	25	25	50	2
8.		Computer Programming Lab.	-	-	3	25	-	25	25	50	2
9.		Engineering Graphics II (M/C Drawing)	-	-	3	25	-	25	25	50	2
10.		Workshop Practice II	-	-	3	25	-	25	25	50	2
	GP-II	GENERAL PROFICIENCY						50	-	50	2
		Total	16	6	12					1000	32

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000,

Total Periods: 34, Total Credits: 32

BRANCH: Agriculture Engineering**YEAR : II****SEMESTER: III**

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Numerical Analysis & Computer Programming (C, C++)	2	1	-	15	10	25	50	75	3
2.		Material Science	2	1	-	15	10	25	50	75	3
3.		Strength of Materials	3	1	-	30	20	50	100	150	4
4.		Fluid Mechanics	3	1	-	30	20	50	100	150	4
5		Soil Science	3	1	-	30	20	50	100	150	4
6.		Mathematics-III	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Fluid Mechanics	-	-	3	25	-	25	25	50	2
8.		Strength of Materials /Material Science	-	-	3	25	-	25	25	50	2
9.		Computer Programming	-	-	3	25	-	25	25	50	2
10.		Soil Science Lab	-	-	3	25	-	25	25	50	2
	GP-III	GENERAL PROFICIENCY						50	-	50	2
		Total	16	6	12					1000	32

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000,

Total Periods: 34, Total Credits: 32

BRANCH: Agriculture Engineering**YEAR : II****SEMESTER: IV**

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Hydrology	2	1	-	15	10	25	50	75	3
2.		Soil Mechanics	2	1	-	15	10	25	50	75	3
3.		I.C. Engines	3	1	-	30	20	50	100	150	4
4.		Kinematics and Dynamics	3	1	-	30	20	50	100	150	4
5		Electrical Machines	3	1	-	30	20	50	100	150	4
6.		Crop Production	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Hydrology	-	-	3	25	-	25	25	50	2
8.		I.C. Engines	-	-	3	25	-	25	25	50	2
9.		Kinematics and Dynamics	-	-	3	25	-	25	25	50	2
10.		Electrical Machines	-	-	3	25	-	25	25	50	2
	GP-IV	GENERAL PROFICIENCY						50	-	50	2
		Total	16	6	12					1000	32

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000,

Total Periods: 34, Total Credits: 32

BRANCH: Agriculture Engineering**YEAR : III****SEMESTER: V**

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Management Science	2	1	-	15	10	25	50	75	3
2.		Surveying and Leveling	2	1	-	15	10	25	50	75	3
3.		Agriculture Engineering Structures & Rural Engineering	3	1	-	30	20	50	100	150	4
4.		Post Harvest Engineering	3	1	-	30	20	50	100	150	4
5		Soil and Water conservation Engineering	3	1	-	30	20	50	100	150	4
6.		Building Materials and Structural Design	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Surveying & Leveling	-	-	3	25	-	25	25	50	2
8.		Agriculture Engineering Structures and Rural Engineering	-	-	3	25	-	25	25	50	2
9.		Post Harvest Engineering	-	-	3	25	-	25	25	50	2
10.		Building Materials and Structural Design	-	-	3	25	-	25	25	50	2
	GP-V	GENERAL PROFICIENCY						50	-	50	2
		Total	16	6	12					1000	32

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000,

Total Periods: 34, Total Credits: 32

BRANCH: Agriculture Engineering**YEAR : III****SEMESTER: VI**

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Pumps Engineering & Hydraulic Control	2	1	-	15	10	25	50	75	3
2.		Ground Water and Well Engineering	2	1	-	15	10	25	50	75	3
3.		Irrigation Engineering	3	1	-	30	20	50	100	150	4
4.		Farm Machinery	3	1	-	30	20	50	100	150	4
5		Refrigeration and Air-conditioning	3	1	-	30	20	50	100	150	4
6.		Machine Design	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Pumps Engineering & Hydraulic Control	-	-	3	25	-	25	25	50	2
8.		Farm Machinery/Irrigation Engineering	-	-	3	25	-	25	25	50	2
9.		Ground Water and Well Engineering	-	-	3	25	-	25	25	50	2
10.		Refrigeration and Air-conditioning	-	-	3	25	-	25	25	50	2
	GP-VI	GENERAL PROFICIENCY						50	-	50	2
		Total	16	6	12					1000	32

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks:

1000, Total Periods: 34, Total Credits: 32

BRANCH: Agriculture Engineering**YEAR : IV****SEMESTER: VII**

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Agriculture and Environment Engineering	3	1	-	30	20	50	100	150	4
2.		Tractors and Power Units	3	1	-	30	20	50	100	150	4
3.		Dairy and Food Processing Operations	3	1	-	30	20	50	100	150	4
4.		Open Elective	3	1	-	30	20	50	100	150	4
5		Profession Elective - I	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Agriculture and Environment Engineering	-	-	3	25	-	25	25	50	2
8.		Tractors and Power Units	-	-	3	25	-	25	25	50	2
9.		Dairy and Food Processing Operations	-	-	3	25	-	25	25	50	2
10.		Project I	-	-	3	25	-	25	25	50	2
	GP-VII	GENERAL PROFICIENCY						50	-	50	2
		Total	15	5	12					1000	30

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000,

Total Periods: 32, Total Credits: 30

BRANCH: Agriculture Engineering

YEAR : IV

SEMESTER: VIII

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
1		Drainage Engineering	3	1	-	30	20	50	100	150	4
2.		Food Products and Process Technology	3	1	-	30	20	50	100	150	4
3.		Instrumentation and Control Engineering in Agriculture	3	1	-	30	20	50	100	150	4
4.		Professional Elective –II	3	1	-	30	20	50	100	150	4
5		Professional Elective – III	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
6.		Project – II	-	-	12	50	-	100	100	200	6
7.											
8.											
	GP-VII	GENERAL PROFICIENCY						50	-	50	2
		Total	15	5	12					1000	28

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000,

Total Periods: 32, Total Credits: 28

Total Credit of All the Four Year : 25

MODEL CURRICULUM AGRICULTURAL ENGINEERING

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ENGLISH FOR PROFESSIONAL COMMUNICATION

Objective of the Course

To impart basic skills of communication in English through intensive practice to the first year UG students of engineering so as to enable them to function confidently and effectively in that language in the professional sphere of their life.

Desired Entry Behaviour

The student must have some basic command of English that is must be able to:

- write reasonably grammatically
- understand (if not use) at least some 2500 general purpose words of English
- use some 2000 (at least 1500) general purpose words of English to express himself in writing and 1500 such words to talk about day-to-day events and experiences of life.
- understand slowly-delivered spoken material in Standard Indian English, and
- speak reasonably clearly (if not fluently) on routine matters with his fello students.

Teaching Method

- The topics must be covered essentially through plenty of examples. Lecture classes must be conducted as lecture-cum-tutorial classes.
- It is a course that aims to develop skills. It is therefore "practical" in orientation. Plenty of exercises of various kinds must be done by the students both inside and outside the class-room.
- The teacher must not depend on a single or a set of two or three text books. He must choose his materials from diverse sources.
- Keeping in view the requirements of his students, the teacher may have to prepare some teaching and exercise materials.
- For practice in listening, good tape recorders can be used if the more advanced facilities (for example, language laboratory) are not available. In fact they can be used very fruitfully.
- The teacher must function as a creative monitor in the class-room.
- Minimum time should be spent in teaching phonetic symbols, stress, intonation, etc. The aim should be to enable the student to find out for himself the correct pronunciation of a word from a learner's dictionary. In teaching speaking, emphasis should be on clarity, intelligibility and reasonable fluency rather than no "correct" pronunciation of words. Classroom presentation and group discussion sessions should be used to teach speaking.

Some Key Concepts

Communication as sharing; context of communication; the speaker/writer and the listener/

reader; medium of communication; barriers to communication; accuracy, brevity, clarity and appropriateness in communication.

Writing

Selecting material for expository, descriptive, and argumentative pieces; business letters; formal report; summarizing and abstracting; expressing ideas within a restricted word limit; paragraph division; the introduction and the conclusion; listing reference material; use of charts, graphs and tables; punctuation and spelling; semantics of connectives, modifiers and modals; variety in sentences and paragraphs.

Reading Comprehension

Reading at various speeds (slow, fast, very fast); reading different kinds of texts for different purposes (for example, for relaxation, for information, for discussion at a later stage, etc.); reading between the lines.

Speaking

Achieving desired clarity and fluency; manipulating paralinguistic features of speaking (voice quality, pitch, tone, etc.); pausing for effectiveness while speaking; task-oriented, interpersonal, informal and semiformal speaking; making a short, classroom presentation.

Group Discussion

Use of persuasive strategies including some rhetorical devices (for emphasizing, for instance; being polite and firm; handling questions and taking in criticism of self; turn-taking strategies and effective intervention; use of body language.

Telephonic Conversation

Listening Comprehension

Achieving ability to comprehend material delivered at relatively fast speed; comprehending spoken material in Standard Indian English, British English and American English; intelligent listening in situations such as an interview in which one is a candidate.

Suggested Text Books & References

- Bhaskar W.W.S. and Prabhu N.S., "English Through Reading", Vol.-I & II, MacMillan, 1978.
- D'Souza Eunice and Shahani G., "Communication Skills in English", Noble Publishing House, 1977.
- Sharma RC. and Mohan K., "Business Correspondence and Report Writing", Tata McGraw Hill, New Delhi, 1994.
- Fiske John, "Introduction to Communication Studies", Rotledge London, 1990.

- Gartside L., "Model Business Letters", Pitman, London, 1992.
- Longman, "Longman Dictionary of Contemporary English", (or 'Oxford Advanced Learner's Dictionary of Current English', OUP), 1998.
- Numberg Maxwell, and Morris Rosenblum, "All About Words", General Book Depot, New Delhi, 1995.

ENGINEERING CHEMISTRY

Atoms and Molecules

Particle in a box illustrating energy quantization, angular momentum quantization, radial and angular parts of H atom wave functions/orbitals, probability and charge distribution. Many electron atoms. Homonuclear and heteronuclear diatomic, covalent bonds, ionic bonds and electro negativity concepts, hybridization and shapes of molecules. Non-covalent interaction (Van Der Waals and hydrogen bonding).

Solid State

Idea of spatial periodicity of lattices; elements of bond theory. Conductors, semiconductors and insulators.

Experimental methods of structure determination using spectroscopic techniques such as IR, UV-Vis, NMR and Mass Spectrometry.

Reaction Dynamics

Rate laws, mechanisms and theories of reaction rates (collision and transition state theory). Lasers in Chemistry.

Electrochemistry

Application of electrode potentials to predict redox reactions in solution with special reference to Lattimer and Frost diagrams.

Transition Metal Chemistry

Structures of coordination compounds corresponding to coordination numbers up to 6. Types of ligands. Isomerism (geometrical, optical, ionization, linkage and coordination). Theories of bonding in coordination compounds, viz. crystal field theory, valence bond theory. Chelation. Brief application in organic synthesis and medicines etc.

Organ metallic Chemistry and Catalysis

Structure and bonding in organ metallic complexes, the sixteen and eighteen electron rules. Homogeneous catalysis, the role of metals in catalytic cycles during some chemical reactions (e.g. hydroformylation, hydrogenation etc.). Role of metals in biology; oxygen carrier, electron transfer.

Structure and Reactivity of Organic Molecules

Inductive effect, resonance, hyper conjugation, electrometric effect. Carbonation, carbanion and free radicals. Brief study of some addition, elimination and substitution reactions. Conformational analysis (a cyclic and cyclic molecules), geometrical and optical isomerism; E, Z and R, S nomenclature.

Polymerization

Basic concepts, classification and industrial application.

Photochemistry

Photo excitation of carbon substrates (Norrish type I and type II reactions), selected examples of the application of photolysis. Photosynthesis (Z-diagram). Chemistry of vision.

List of Experiments

- Acid-base titration (estimation of commercial caustic soda).
- Redox titration (estimation of iron using permanganometry).
- Complex metric titration (estimation of hardness of water using EDT A titration).
- Preparation and analysis of a metal complex (for example thiourea/copper sulfate or nickel chloride/ammonia complexes).
- Chemical kinetics (determination of relative rates of reaction of iodide with H₂O₂ at room temperature (clock reaction)).
- Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
- Photochemical oxidation-reduction (study of photochemical reduction of ferric salt).
- Viscosity of solutions (determination of percentage composition of sugar solution from viscosity).
- Synthesis of aspirin.
- Synthesis of p-nitro aniline from acetanilide.
- Detection of functional groups in organic compounds.
- Utilization of paper/thin layer/column chromatographic techniques in the separation of organic compounds.
- Radical polymerization of vinyl monomers such as styrene, acrylonitrile etc.
- Conductometric titration (determination of the strength of a given HCl solution by titration against a standard NaOH solution).

Suggested Text Books & References

- "Blocks 1-5 of Chemistry Course", Indira Gandhi Open University, IGNOU, New Delhi, 1996.
- Alberty R.A. and Silbey R. J., "Physical Chemistry", John Wiley & Sons, Inc., Singapore, 1996.

- Cotton F.A., Wilkinson G. and Gaus P.L., "Basic Inorganic Chemistry", John Wiley & Sons, Inc., Singapore, 3rd Ed., 1996.
- Graham-Solomon T.W., "Fundamentals of Organic Chemistry", John Wiley & Sons, Inc., Singapore, 1997.
- Odian T.W., "Principles of Polymerization", John Wiley & Sons, Inc., New York, 1981.
- Sykes P., "A Guidebook to Mechanism of Organic Chemistry", Longman Inc., New York, 1981.
- Dye J.R. r, "Application of absorption Spectroscopy of Organic Compounds", Prentice Hall of India, 1965.
- Williams D.H. and Fleming I., "Spectroscopic Methods in Organic Chemistry", Tata McGraw Hill Edition, New Delhi, 4th Ed., 1988.
- Atkins P.W., "Physical Chemistry", Oxford Univ. Press, 4th Ed., 1990.
- Pine S.H., "Organic Chemistry", McGraw Hill Book Co., New Delhi, 5th Ed., 1987.
- Sharma B.K., "Engineering Chemistry", Krishna Prakashan Media (P) Ltd., Meerut, 1996.
- Conn E.E. and Stumpf P.K., "Outlines of Biochemistry", Wiley Eastern Ltd., New Delhi, 4th Ed., 1985.
- Morrison R.T. and Boyd R.N., "Organic Chemistry", Prentice Hall of India, 6th Ed., 1992.
- Rao C.N.R. and Agarwala U.c., "Experiments in General Chemistry", East-West Press, New Delhi, 1969.
- Furnis B.S., Hannaford A.J., Smith P.W.G. and Tatchell A.R., Vogel's "Textbook of Practical Organic Chemistry", ELBS, 5th Ed., 1989.
- Vogel's "Textbook of Quantitative Analysis", Longman, New York, 4th Ed., 1978.
- Elias A.R., Sundar Manoharan S. and Raj R., "Laboratory Experiments for General Chemistry", I.I.T. Kanpur, 1997.

ENGINEERING PHYSICS-I

Theory of Relativity

Inertial frame of reference, Noninertial frames and fictitious forces, Outline of relativity, Michelson-Morley experiment, Lorentz transformation of space and time, length contraction, variation of mass with velocity, equivalence of mass and energy.

Geometrical Optics

Combination of thin lenses, cardinal points of coaxial system of thin lenses, thick lenses, location and properties of cardinal points, graphical construction of images:

Physical Optics

Interference- analytical treatment of interference, intensity distribution of fringe system, coherent and non-coherent sources, fundamental conditions of interference, Fresnel's biprism, displacement of fringes, wedge shaped films, Newton's rings

Diffraction- single slit and double slit diffraction, diffraction grating, Limit of resolution, resolving power of grating and image forming systems.

Polarisation- Brewster's law, double refraction, geometry of calcite crystal, optic axis, nicol prism, circularly and elliptically polarised light, retardation plates, production and analysis of planes, polarimeter

Thermal Physics

Kinetic theory of gases, maxwellian distribution, mean free path, transport phenomena in gases, Imperfect gases and vander Waal's equation of state.

Acoustics'

Production and applications of Ultrasonics, Acoustics of buildings.

Dynamics of fluids

Continuity equation, Bernoulli's theorem and its applications, Torcelli's theorem, Viscosity, flow of liquid through a capillary tube, capillaries in series and parallel, Stoke's formula, rotation viscometer.

List of Experiments

- To determine the coefficient of viscosity of water by capillary flow.
- To determine the thermal conductivity of a bad and good conductor by Lee's method and Searl's method, respectively.
- To determine the wave length of light by Newton's ring method.
- To determine the wave length of light by Fresnel's biprism.
- To determine the dispersive power of the given material of the prism.
- To determine the focal length of combination of two thin lenses by nodal slide assembly and its verification.
- Determination of e/m by I. J. Thomson's method.
- Measurement of thermo emf between different types of thermocouples as a function of temperature difference between the junction, measurement of an unknown temperature.
- Use of Carry Foster Bridge.
- Study of electromagnetic induction.
- Study of electromagnetic damping and determination of terminal velocity reached by a magnet falling in a metallic tube.
- Study of LCR circuits with AC current.
- Determination of Plank's Constant using photocells.

Suggested Text Books & References

- Jenkins and White, " Optics", McGraw-Hill Book Company.

- Mathur D.S., "Mechanics"
- Saha and Srivastava "A treatise on heat"
- Singh R.B. "Physics of Oscillations and Waves"
- Ghatak A.K. "Optics"

MATHEMATICS - I

Calculus of Functions of One Variable

Successive differentiation, Leibnitz's theorem (without proof). Rolle's theorem mean value theorems and Taylor's theorem. Fundamental theorems of integral calculus, elementary reduction formulae for integrals. Applications to length, area, volume, surface area of revolution, moments and centers of gravity.

Infinite Series: Convergence, divergence, comparison test, ratio test, Cauchy Leibnitz's theorem, absolute and conditional convergence. Expansions of functions into Taylor and Maclaurin series.

Calculus of Functions of Several Variables

Partial derivatives, chain rule, gradient and directional derivative. Differentiation of implicit functions, exact differentials. Tangent planes and normals. Maxima, minima and saddle points. Simple problems in extreme of functions with constraints - method of Lagrange multipliers. Multiple integrals - double and triple integrals. Jacobians and transformations of coordinates. Applications to areas, volumes etc.

Vector Calculus

Scalar and vector fields. Line and surface integrals. Gradient, divergence and curl. Line integrals independent of path. Green's theorem, divergence theorem and Stoke's theorem (without proofs) and their simple applications.

Suggested Text Books & References

- Thomas G. B. and Finney R. L., "Calculus and Analytic Geometry", 6th edition, Addison- Wesley/Narosa, 1985.
- Piskunov, "Differential and Integral Calculus", Vol.-I & II, Mir Publishers, Moscow, 1979.

ENGINEERING MECHANICS

Fundamental of Mechanics- Basic concepts

Force Systems and Equilibrium

Force, Moment and couple, Principle of Transmissibility, Varignon's theorem, Resultant

of force systems-Concurrent and non-concurrent coplanar forces, Free body diagram, Equilibrium equations and their uses in solving elementary engineering problems.

Plane Trusses

The structural model, simple trusses, analysis of simple trusses: method of joints, method of sections, graphical method.

Friction

Introduction, laws of coulomb friction, simple contact friction problems, belt friction, the square screw thread, rolling resistance.

Properties of Surfaces

First moment of an area and centroid, second moment and product of area of plane area, transfer theorems, relation between second moment and product of area, polar moment of inertia, principal axes, mass moment of inertia.

Virtual Work

Work of a force, Principle of Virtual work and its application.

Kinematics of Rigid bodies

Plane motion, Absolute motion, Relative motion, Translating axes and rotating axes.

Kinetics of Rigid bodies

Plane motion, Work and energy, Impulse and momentum.

List of Experiments

- To determine the Newton's second law of motion by Fletcher's trolley apparatus.
- To determine the moment of inertia of a flywheel about its axis of rotation.
- To verify: (a) the conditions of equilibrium of forces by parallel force apparatus.

(b) The principal of moments by crank lever.
- To find the compression in the rafters and tension in ties of simple roof truss models and to verify graphically.
- To determine the dry friction between inclined plane and slide boxes of different materials.
- To determine the coefficient of friction between the belt and rope and the fixed pulley.
- To determine the velocity ratio of a simple screw jack and to plot graph between (a)

- Effort-Load. (b) Friction-Load. (c) Efficiency-Load.
- To measure the area of a figure with the help of a Polar Planimeter.

Suggested Text Books & References

- Beer.F.P. and Johnston. F. R., "Mechanics for Engineers", McGraw Hill.
- Shames,I.H., " Engineering Mechanics", Prentice Hall of India
- Meriam,J.L., "Statics", John Wiley.
- Meriam,J.L., "Dynamics", John Wiley.

BASIC ELECTRICAL ENGINEERING

DC Networks

Kirchoff's laws, node voltage and mesh current methods; Delta-star and star-delta conversion; Classification of Network Elements, Superposition principle, Thevenin's and Norton's theorems.

Single Phase AC Circuits

Single phase EMF generation, average and effective values of sinusoids; Solution of R, L, C series circuits, the j operator, complex representation of impedances; Phasor diagram, power factor, power in complex notation; Solution of parallel and series-parallel circuits; Resonance.

Three phase AC Circuits

Three phase EMF generation, delta and Y -connection, line and phase quantities; Solution of three phase circuits, balanced supply voltage and balanced load; Phasor diagram, measurement of power in three phase circuits; Three phase four wire circuit; Unbalanced circuits.

Magnetic Circuits

Ampere's circuital law, B-H curve, solution of magnetic circuits; Hysteresis and eddy current losses; Relays, an application of magnetic force.

Transformers

Construction, EMF equation, ratings; Phasor diagram on no load and full load; Equivalent circuit, regulation and efficiency calculations; Open and short circuit tests; Auto-transformers and three phase transformers.

Induction Motors

The revolving magnetic field, principle of operation, ratings: Equivalent circuit; Torque-speed characteristics; Starters for squirrel cage and wound rotor type induction motors; Single phase induction motors.

DC Machines

Construction EMF and torque equations;

ENGINEERING GRAPHICS-I

General

Importance, Significance and scope of engineering drawing, Lettering, Dimensioning, Scales, Sense of proportioning, Different types of projections, Orthographic projections, B.I.S. Specifications.

Projections of Points and Lines

Introduction of planes of projection, Reference and auxiliary planes, projections of points and lines in different quadrants, traces, inclinations, and true lengths of the lines, projections on auxiliary planes, shortest distance intersecting and non-intersecting lines.

Planes Other than the Reference Planes

Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points and lines lying in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.

Projections of Plane Figures

Different cases of plane figures (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one or both reference planes). Obtaining true shape of the plane figure by projection.

Projection of Solids

Simple cases when solid is placed in different positions, Axis, faces and lines lying in the faces of the solid making given angles.

Development of Surface

Development of simple objects with and without sectioning.

Isometric Projection

Nomography

Basic concepts and use.

Suggested Text Books & References

- Narayana, K.L. and Kannaiah, P. "Engineering Graphics.", Tata McGraw Hill, New Delhi, 1988.
- Bhatt, N.D. "Elementary Engineering Drawing", Charotar Book Stall, Anand, 1998.
- Lakshminarayanan, V. and Vaish Wanar, R.S. , "Engineering Graphics", Jain Brothers, New Delhi, 1998.
- Chandra, A.M. and Chandra Satish, "Engineering Graphics", Narosa, 1998.

WORKSHOP PRACTICE I - II

Carpentry

Timber, definition, engineering applications, seasoning and preservation, plywood and plyboards.

Foundry

Moulding sands, constituents and characteristics. Pattern, definition, materials, types, core prints. Role of gate, runner, riser, core and chaplets. Causes and remedies of some common casting defects like blow holes, cavities, inclusions.

Metal Joining

Definitions of welding, brazing and soldering processes, and their applications. Oxygen acetylene gas welding process, equipment and techniques, type of flames and their applications. Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrode coating. Welding positions. Type of weld joint. Common welding defects such as cracks, undercutting, slag inclusions. porosity.

Metal Cutting

Introduction to machining and common machining operations. Cutting tool materials. Definition of machine tools, specification and block diagram of lathe, shaper, drilling machine and grinder. Common lathe operations such as turning, parting, chamfering and facing. Quick return mechanism of shaper, Difference between drilling and boring. Files material and classification.

Forging

Forging principle, materials, operations like drawing, upsetting, bending and forge welding, use of forged parts.

List of Jobs to be Made In the Workshop Group A

- | | | | |
|----|--------------------------------|-------------------|-------|
| 1. | T - Lap joint and Bridle joint | (Carpentry shop) | 4 hrs |
| 2. | Mould of any pattern | (Foundry shop) | 2 hrs |
| 3. | Casting of any simple pattern | (Foundry shop) | 2 hrs |

Group B

- | | | |
|----|---|-------|
| 1. | (a) Gas welding practice by students on mild steel flat | 2 hrs |
| | (b) Lap joint by Gas welding | |
| 2. | (a) MMA Welding practice by students | 2 hrs |
| | (b) Square butt joint by MMA Welding | |
| 3. | (a) Lap joint by MMA Welding | 1 hr |
| | (b) Demonstration of brazing | 1 hr |
| 4. | Tin smithy for making mechanical joint and soldering of joints. | 2 hrs |

Group C

- | | | |
|----|--|-------|
| 1. | Job on lathe with one step turning and chamfering operations. | 2 hrs |
| 2. | Job on shaper for finishing two sides of a Job. | 2 hrs |
| 3. | (a) Drilling two holes of size 5 and 12 mm diameter on job used/to be used for shaping | |
| | (b) Grinding a comer of above job-on bench grinder | 2hrs |
| 4. | Finishing of two sides of a square piece by filing | 2 hrs |

Suggested Text Books & References

- Begeman, M.L. and Amstead B.,II., "Manufacturing Process", John Wiley, 1968.
- Chapman, W.A.J. and Arnold .E., "Workshop Technology", Vol. I.& III, Viva Low Priced Student Edition, 1998.
- Raghuwanshi, B.S., "Workshop Technology", Vol. I & II, Dhanpat Rai and Sons, 1998.
- Chaudhary Hajra, "Elements of Workshop Technology", Media Promotors & Publishers 1997.
- Crawford, S. "Basic Engineering Processes", Hodder & Stoughton, 1985

INTRODUCTION TO COMPUTING

Introduction

Introduction to the computer devices such as keyboard, mouse, printers, disk files, floppies; etc. Concept of computing, contemporary, OSs such as DOS, Window 95, MAC-OS, UNIX, etc. (Only brief user level description).

Introduction to the e-mail, ftp, rlogin and other network services, world wide web.

Introduction to the typesetting softwares such as Microsoft office:

Introduction to' Programming

Concept of algorithms, Example of Algorithms such as how to add ten numbers, roots of a quadratic equation. Concept of sequentially following up the, step~ of the algorithm. '0' Notion of program, programmability and programming Languages, Structure of programs, object codes, compilers.

Introduction to the Editing tools such as vi or MS- VC editors.

Concepts of the finite storage, bits, bytes, kilo, mega and gigabytes. Concepts of character representation. Languages for system programming: study of Basics, Fortran. Pascal, Cobol etc.

Computer Programming Lab

Concepts of flow charts and decision tables, Examples and practice problems.

Introduction to Digital computers and its components, Introduction to DOS and UNIX operating systems.

Development of computer 'program for. example

- Roots of quadratic and Cubic 'equations
- Summation of N natural numbers
- Arranging numbers in ascending and descending orders
- Separation of odd and even numbers, etc.

Suggested Text Books & References

- Kernighan, B. W., " The elements' of programming style ", McGraw Hill.
- Yourdon, E., "Techniques of program structures and design", Prentice Hall.
- Press W.H., Teukolsky S.A., Vetterling W.T.& Flannery B.P., " Numerical Recipies

- in .. Fortran", Cambridge university press.
- Gotterfried B.S, "Schaum's outline of theory & programming with basic", McGraw Hill New Delhi.
- Schied F.S., " Theory and Problems of Computers & Programming"; McGraw Hill, New Delhi.

ENVIRONMENT AND ECOLOGY

General

Introduction, components -of the environment; environmental degradation.

Ecology

Elements of Ecology: Ecological balance and consequences of change, principles of environmental impact assessment.

Air Pollution and Control

Atmospheric composition, energy balance, climate, weather, dispersion, sources and effects of pollutants, primary and secondary pollutants, green house effect, depletion of ozone layer, standards and control measures.

Water Pollution and Control

Hydrosphere, natural water, pollutants their origin and effects, river/lake/ground water pollution standards and control.

Land Pollution

Lithosphere, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes): their origin and effects, collection and disposal of solid waste, recovery and conversion methods.

Noise Pollution

Sources, effects, standards and control.

Suggested Text Books & References

- Masters, G.M., "Introduction to Environmental Engineering and Science", Prentice Hall of India Pvt. Ltd., 1991.
- Nebel, B.J., "Environmental Science", Prentice-Hall Inc., 1987.
- Odum, E.P., " Ecology: The Link between the natural and social sciences", IBH

Publishing Com. Delhi.

ENGINEERING PHYSICS-II

Vector analysis

Scalar and vector fields, gradient of a scalar field, Divergence and curl of a vector fields, Line integral of a vector field, Gauss- divergence theorem, Stoke's theorem

Electromagnetism

Quantization & conservation of charge, Coulomb's law (vectorial form) and superposition principle,

Concept of electric field lines, flux of E-field, Gauss' law, Electric Potential energy and potential,

Conductors, capacitors and dielectric materials, Magnetic field, Force on a moving charge in a magnetic field, Force on current element, Torque on current loop, Biot-Savart law, Ampere's

law, Electromagnetic induction and Faraday's law, Magnetism in materials .Maxwell's equations, Electromagnetic Waves.

Thermoelectricity

Seebeck effect, law of successive temperatures, law of intermediate metals, peltier effect, Thomson effect, Thermoelectric power, application of thermodynamics on thermocouple.

Modern Physics

Elements of wave properties of particles and particle properties of waves, Nuclear Energy, Lasers- spontaneous and stimulated emission of radiation, Einstein coefficient, Parts of laser, types of lasers and their application.

Solid State Devices

Energy band diagram; covalent bonds; bound and free electrons, holes; electron and hole mobilities; intrinsic and extrinsic semiconductors; Fermi and impurity levels; impurity compensation, charge neutrality equation and semiconductor conductivity; Einstein relation; drift and diffusion current; photo conductivity and Hall effect.

Suggested Text Books & References

- Rangwala and Mahajan "Electricity and Magnetism", Tata McGraw Hill, 1998.
- Verma,H.C., "Concepts of Physics, Part-2", Bharati Bhawan (P&D), 1998.
- Beiser, "Modern Physics", McGraw-Hill Inc., New York, 1995.

- Mani and Mehta, G.K. "Modern Physics", Affiliated East-West Press Pvt. Ltd, 1998.

MATHEMATICS - II

Linear Algebra

Vector spaces - linear independence and dependence of vectors, inner products, linear transformations. Matrices and determinants. Systems of linear equations - consistency and inconsistency. Gauss elimination, rank of a matrix, inverse of a matrix. Eigen values and eigenvectors of a matrix, diagonalization of a matrix.

Ordinary Differential Equations

Formation of ODE's, definition of order, degree and solutions. ODE's of first order: separable variables, homogeneous and nonhomogeneous equations, exactness and integrating factors, linear equations and Bernoulli equations. General linear ODE's of nth order: solutions of homogeneous and nonhomogeneous equations, operator method, methods of undetermined coefficients and of variation of parameters. Solutions of simple simultaneous ODE's.

Laplace Transforms

Transforms of elementary functions, transforms of derivatives and derivatives of transforms, inverse transforms, transforms of periodic functions, unit step function, shifting theorems, solutions of ODE's using Laplace transforms.

Numerical Methods

Difference operators - forward, backward, central, shift and average operators and relations between them. Newton's forward and backward interpolation. Lagrange interpolation and the error formula for interpolation. Numerical differentiation and integration - Trapezoidal rule and Simpson's one-third rule including error formulas.

Suggested Text Books & References

- Kreyszig, E. "Advanced Engineering Mathematics", 5th Ed., Wiley Eastern, 1985.
- Krishnamurthy, V. Mainra V.P. and Arora, J.L. "An Introduction to Linear Algebra", Affiliated East-West, 1976.
- Boyce and DiPrima, R.C. "Elementary Differential Equations and Boundary Value Problems", 3rd Ed., Wiley, 1977.

ENGINEERING THERMODYNAMICS

Fundamentals and Definitions

System, Control Volume, properties, state, state change, and diagram, Dimensions and units.

Work

Mechanics and Thermodynamics definitions, Displacement work at part of a system boundary, Engine Indicator, Displacement work in various quasi-static processes, shaft work, electrical work.

Heat

Temperature, thermal equilibrium, zeroth law of thermodynamics, sign convention for heat transfer.

First Law of Thermodynamics

Statement, Application to non-cyclic process, Energy, modes of energy, pure substance, Specific heats, First Law for Control Volumes.

Second Law of Thermodynamics

Direct and reversed heat engines, Kelvin-Planck and Clausius Statements and their equality, reversible and irreversible processes, Carnot cycle, Thermodynamic temperature scale.

Entropy

Definition, calculation through. Tds relations, T-s diagrams, entropy as a measure of irreversibility Properties of pure substances - Use of steam Tables and Mollier Diagram.

Ideal gas

Properties of ideal gas and ideal gas mixtures with and without a condensable vapour- psychrometry .

Real gas

Equations of state, generalised charts for compressibility, enthalpy changes and fugacity.

Second Law Analysis of Engineering Processes

Availability and irreversibility and their application in Thermal Engineering.

Suggested Text Books & References

- Spalding, D. B. and Cole, E.H., "Engineering Thermodynamics", Edward Arnold, 1959.
- Hawkins, G.A., "Engineering Thermodynamics", John Wiley and Sons, 1955.
- Van Wylen, G. J. and Sonntag, R.E., "Fundamentals of Classical Thermodynamics", John Wiley and Sons, 4th edition, 1997.
- Nag,P.K., "Engineering Thermodynamics", Tata McGraw Hill, 2nd edition, 1998.

BASIC ELECTRONICS

Semiconductor Diodes

Introduction, Ideal diode, PN semiconductor diode, Diode equivalent circuits, Zener diode, Light diodes,

Bipolar Junction Transistor

Introduction, Transistor construction, Transistor operation, Common-base configuration, common emitter and common collector configuration.

Field Effect Transistor

Introduction, Construction and characteristics of JFETs, Transfer characteristics, Depletion type MOSFET, Enhancement type MOSFET.

Operational Amplifier

Introduction, Differential and common mode operation, Constant gain multiplier, voltage summing, voltage buffer.

Semiconductor Devices

Introduction of silicon controlled rectifier, GTO, TRIAC, DIAC, injection transistors, IGBT.

Cathode Ray Oscilloscope

Introduction, Cathode ray tube- theory & construction.

Electronic Instruments

Introduction, Electronic voltmeters, Vacuum type voltmeters, Differential amplifiers, D.C, Voltmeter with direct coupled amplifier, Electronic multimeter.

Transducers

Introduction, classification and types of electrical transducers.

Display Devices and Recorders

Introduction, Digital instruments, Digital Vs Analog instruments, Recorders- Analog recorders, graphic recorders, strip-chart recorders.

Data Acquisition Systems

Introduction, Components and uses.

NUMERICAL ANALYSIS AND COMPUTER

PROGRAMMING, C.C ++

Numerical Analysis

Approximations and round of errors, Truncation errors and Taylor Series,

Determination of roots of polynomials and transcendental equations by Newton-Raphson, Secant and Bairstow's method.

Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and Gauss Siedel iteration methods.

Curve fitting- linear and nonlinear regression analysis.

Backward, Forward and Central difference relations and their uses in

Numerical differentiation and integration, Application t of difference relations in the solution of partial differential equations. .

Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge Kutta and Predictor-Corrector method.

Computer Programming

Introduction to computer programming in C and C++ languages. Arithmetic expressions, Simple programmes. The emphasis should be more on programming techniques rather than the language itself. The C programming language is being chosen mainly because of the - availability of the compilers, books and other reference materials.

Example of some simple C program. Dissection of the program line by line. Concepts of

variables, program statements and function calls from the library (print for example)

C data types, int, char, float etc.

C expressions, arithmetic operations, relational and logic operations.

C assignment statements. extension of assignment to the operations. C primitive input output using getchar and put char, exposure to the scanf and printf functions.

C statements, conditional execution using if, else. Optionally switch and break statements may be mentioned.

Concepts of 'loops, example of loops in C using for, while and do-while. Optionally continue may be mentioned.

One dimensional arrays and example of iterative programs using arrays, 2-d'arrays. Use in matrix computations.

Concept of Sub-programming, functions. Example of functions. Argument passing mainly for the simple variables.

Pointers, relationship between arrays and pointers. Argument passing using pointers. Array of pointers, Passing arrays as arguments.

Strings and C string library.

Structure and unions. Defining C structures, passing structures as arguments. Program examples.

File I/O. Use of fopen, fscan fand fprint routines.

Lab

Development of computer program for

Numerical integration by Trapezoidal and Simpson's rule

Gauss-Siedel iteration method

Various matrix operation and their use as sub-routines

Uses of pointers, data structure, loops, arrays.

Suggested Text Books & References

- Shastry S.S., "Numerical Methods", Prentice Hall Inc., India, 1998.
- Noble Ben, "Numerical Methods", New York International Publications, New York,

- 1964.
- Stanton Ralph G., "Numerical Methods for Engineering", Englewood Cliffs, N.J., Prentice Hall Inc., 1961.
 - Buckingham R.A., "Numerical Methods", Sir Isaac Pitman Sons. Ltd., London, 1957.
 - Bakhvalov N.S., "Numerical Methods", Mir. Pub., Moscow, 1977.
 - Grewal B.S., "Numerical Methods", Khanna Pub., New Delhi, 1998.
 - Kaicker, Sudhit. "The Complete ANSI C", BPB Publications, New Delhi, 1996.
 - B.W. Kernighan and D.M. Ritchie, "The C Programming Language", Prentice Hall of India, 1998.
 - Byron S. Gottfreid, "Programming with C", Tata McGraw Hill, 2nd edition 1998.

MATERIAL SCIENCE

Crystal Structures

Space lattice and crystal structures, Determination of Crystal structure by X-ray technique, Imperfections in crystals like point, line and planar defects. Influence of imperfections on properties of materials, Dislocation multiplication. Diffusion, Mechanisms, Laws and applications.

Behaviour of Materials

Elastic an elastic and viscoelastic behaviour of materials, plastic deformation, strain hardening, Yield point phenomena, Ductile and brittle fracture.

Mechanical Properties of Materials

Tensile and compression test, shear test, fatigue test, hardness test, impact test, Creep strength of mater ails.

Dielectric Materials

Principles, temperature and frequency effects, ferroelectric materials

Polymers

Types, properties, additives, application.

Material Science Lab

- To study the lattice structure of various types of unit Cells. Observe the Miller Indices for various Planes and directions in a unit Cell.
- To study the micro-structure of Cast Iron, Mild Steel, Brass Solder Under, Annealed, Cold Worked, forged/rolled conditions.

- To verify the Hall effect-
- To determine the fracture characteristics of ductile and brittle materials.
- To determine the chemical composition of a few common alloys.
- To determine %age of C and S content in an alloy with Fe as main constituent.

Suggested Text Books & References

- Vlack, Van. "Material Science for Engineers".
- Raghavan, V. "Material Science and Engineering", Prentice Hall.
- Callister," Material Science and Engineering", astern Wiley.

STRENGTH OF MATERIALS

Introduction

Simple Stresses and Strains

Normal and shearing stresses in axially loaded members; Concept of factor of safety; Normal and shearing strains; Stress strain relationship; Hook's law; Modulus of rigidity; Complementary shear stress; Poisson's ratio; Bulk modulus; Relation between various elastic constants; Volumetric strain.

Mechanical Properties of Materials

Definition of elastic materials; Plastic materials; Ductile materials; Brittle materials; Permanent set; Elastic limit, Fatigue Limit; Ultimate strength; Modulus of resilience; Modulus of toughness; Modulus of rupture; Proof stress; Malleability; Toughness and hardness and their measurement.

Mechanics of Rigid Bodies

Types of forces; Types of supports; Resultant and equilibrium of forces; Free body diagram; Resolution and composition of forces.

Centroid and Moment of Inertia

Centroid and centre of gravity; Second moment of inertia; Polar moment of inertia; Radius of gyration.

Bending Moment and Shear Force

Definition and concept; SFD and BMD for cantilever; Simply supported and over hanging beams subjected to various combination of loadings; Point of inflection; Elastic curves; Relation between the load S.F. and B.M.

Simple Theory of Bending

Flexure formula; Stress variation and different types of beam sections; Beams of uniform strength; Composite beams.

Combined Stresses

Combined bending and axial stresses; Eccentricity about one axes and about both the axes; Condition for no tension in the section; Application to dam section and wind resisting sections.

Torsion of Shafts.

Torsion's formula; Maximum torque transmitted by a solid and hollow circular shaft; Shear stress; power transmitted by a shaft; Circular shaft under combined bending and torsion.

Shear Stress for Beams

Expression-for shear stress; shear stress variation in different types of beam sections.

Complex Stresses

Principal stresses and strains; shear stress; Mohr's circle method; theory of elastic failures.

Slope and Deflection

Statically determinate beams using Macaulay's method; Area moment method and conjugate beam method

Thin Pressure Vessels

Circumferential and longitudinal stresses in cylindrical shell; Spherical shell under internal pressure.

List of Experiments

- Introduction to testing equipments
- Uniaxial tension test (Mild steel, Timber)
- Uniaxial compression test (Timber-along and across, concrete, bricks, etc.)
- Torsion test (Mild steel/aluminium).
- Bending stress distribution in beams using demec gauges and extensometer,
- .Analysis of truss model with spring members.
- Compression test on brick masonry specimen,
- Hardness Test

- Creep Test
- Impact Test
- Strength of Etched and Un-etched glass
- Spring test
- To study the microstructure of various metals

Suggested Text Books and References

- Singh, Surendra. "Strength of Materials". Vikas Publishing House Pvt. Ltd., New Delhi.
- Jain, O.P. and Jain, B.K. "Theory and Analysis of Structures". Vol. I. Nemchand and Bros. Roorkee.
- Popov, E.P: "Mechanics of Materials". Prentice Hall of India, 1993.
- Beer and Johnston. "Mechanics of Materials". McGraw Hill Book Company, 1987.
- Timoshenko and Young. "Strength of Materials". Van Nostrand and Company, 1993.

FLUID MECHANICS

Definition and properties of fluids

r

Units of measurement; fluid statics: pressure at a point and its measurement, fluid static force on submerged surfaces, buoyancy, condition of floatation and stability of submerged and floating bodies.

Kinematics of fluids

Lagrangian and Eulerian description of fluid motion, stream lines, path lines, streak lines; types of fluid flow: translation, rotation, circulation and vorticity; stream function, velocity potential and flow net; discharge: system, control volume and cross section; stress-strain rate relationship, linear and angular momentum theorems and applications; some exact solutions of Navier-Stokes equations.

Dynamics of fluid

Transport theorem, conservation laws, equation of continuity, Euler's equation of motion, Bernoulli's equation, viscous flow.

Dimensional analysis and similitude

Raleigh's method and Buckingham's Pi theorem, types of similarities, dimensional analysis, dimensionless numbers.

Internal flow

Laminar and turbulent flow in pipes, general equation for head loss - Darcy- Weisbach and Fanning's equations, Moody's diagram, energy losses through pipe fittings, flow through network of pipes .

Non-Newtonian fluid flow

Power law representation of shear stress - shear rate relationship, measurement of flow behaviour index and consistency coefficient, generalised viscosity coefficient.

Concept of boundary layer, hydrodynamic forces on immersed bodies

Drag and lift; flow through orifices, mouthpieces and over weirs and notches; flow in open channels.

Laboratory

- Study of pressure measuring devices.
- Relationship between depth of liquid and pressure exerted by it.
- Determination of metacentric height of floating vessels.
- Determination of pressure drop flow rate relationship for flow of air through packed bed and fluidization velocity.
- Determination of flow pattern, port arrangement and pressure drop in a plate heat exchanger.
- Verification of Bernoulli's theorem.
- Demonstration of laminar and turbulent flows.
- Determination of head loss through pipes and pipe fittings. Determination of coefficient of discharge for a venturimeter.
- Determination of orifice meter coefficient.
- Calibration of a notch.
- Measurement of non-Newtonian parameters of liquid foods. Determination of forces on submerged bodies.
- Flow visualization using smoke in a transparent tube to demonstrate path line, streak line, laminar and turbulent flows
- Experiments using water table to demonstrate various flow phenomena.
- Measurement of viscosity and surface tension of liquids.
- Demonstration of momentum theorem using impulse and reaction turbines ..
- Estimation and measurement of flow rate through single screw extruder.

Instruments/Equipment

Many of these experiments require very small investment for construction and experimentation. A large number of experiments can be carried out if a good water-table is designed and developed. Some of the major instruments are as follows:

Plate heat exchanger, single screw extruder, Brookfield viscometer, constant-head water table, pressure gauge, floating vessels, venturi meter, measuring tanks etc.

Suggested Text Books & References

- Streeter V.L. and Wylie, E.B. "Fluid Mechanics", McGraw Hill, 1 st SI Ed., 1983.
- Shames, I.H. "Mechanics of Fluids", McGraw Hill International, 2nd Ed .. , 1989.
- Roy, D.N. "Fluid Mechanics", East-West Publication, 1995 ..
- Lal, Jagdish. "Fluid Mechanics and Hydraulics", Metropolitan Book Co., New Delhi. 1969.
- Khurmi, R.S."A Text Book of Fluid Mechanics", S Chand and Co., New Delhi, 1982

SOIL SCIENCE

Soil genesis and classification

Weathering, formation and composition of soil, classification of soils.

Soil colloids

Inorganic and organic colloids, their nature and physico-chemical properties, ion exchange phenomena, and nutrient availability.

Mineral nutrition of plants

Essential elements, chemical fertilizers, organic manures.

Physics of soil

Texture, structure and basic physical properties, retention and movement of soil water, permeability and ground water flow, gaseous exchange, soil strength and thermal properties of soil.

Soil tillage

Types of tillage and their influence on soil physical properties and crop performance.

Soil management

Management of acid, saline, sodic, highly and slowly permeable soils, water quality ..

Laboratory

- Determination of soil pH and soil electrical conductivity

- Estimation of soil organic matter
- Estimation of cation exchange capacity
- Determination of major available nutrients
- Determination of particle size distribution
- Estimation of single value soil physical constants .
- Determination of soil particle and bulk density
- Measurement of soil strength
- Evaluation of liquid and plastic limits
- Compactibility test
- Determination of soil water
- Evaluation of water - retention characteristics of soil
- Measurement of saturated hydraulic conductivity of-soil
- Measurement of infiltration rate
- Evaluation of water quality

Instruments Equipment

pH meter, conductivity meter, spectrophotometer, flame photometer, pressure plate apparatus, permeability rack, double ring infiltrometer, depth core sampler, cone penetrometer, Casagrande apparatus, water quality checker, compactometer.

Suggested Text Books & References

- Brady, N.C. "Nature and Properties of Soils", New YORK, Macmillan, 1990.
- Biswas TD. and Mukherjee, S.K. "text Book of Soil Science" 'New Delhi, Tata Mgraw,1987.
- Ghildyal B.P. and Tripathi, R.P. "Soil Physics", Wiley eastern Ltd, 1987.
- Hillel, D. "Introduction to Soil Physics" , San Diego, Academic press, 1982.
- Singer Michael J. and Munns, D.N. "Soils - An Introduction" , 1983. /
- Foth, Henry D "Fundamentals of Soil Science", New Delhi, Wiley Eastern, 1972.
- Tandon, H.L.S "Methods of Analysis of Soils, Plants, Waters and Fertilisers" , 1985.

MATHEMATICS - III

Complex Variable ..

Complex number, Complex functions, limit, Continuity and differentiability, Cauchy-Ann equations, harmonic functions, construction of analytic functions by Mile-Thomson method,

Conformal mapping, transformations $W=Z^n$, $1/z$, $e^{(az+b) / (cz-d)}$.

Fourier Series

Periodic functions, trigonometric series, Fourier series, Euler's formula, even and odd functions, functions having arbitrary period., half-range sine and cosine series. Determination of Fourier coefficients without integration.

Laplace Transform

Unit step function, Dirac delta function- their Laplace transforms, second shifting theorem, Laplace transform of the periodic functions, applications.

Series Solution of Differential Equation

Series solution, Frobenius method, Legendre and Bessel's equations.

Partial Differential Equation

Linear and non-linear partial differential equations of first order, four standard forms

Suggested Text Books & References

Kreyszig, E. "Advanced Engineering Mathematics", 5th Ed., Wiley Eastern, 1985. Schume Series,

HYDROLOGY

Introduction

Hydrologic cycle; schematic diagram; Explaining different components of hydrologic cycles.

Meteorological Parameters and Their Measurements.

Precipitation: Its different forms viz. snow, sleet, rain, hail etc. and their measurement technique: Evaporation, estimation and measurement techniques; Evapotranspiration, estimation and measurement techniques; Wind, measurement techniques for velocity and direction.

Precipitation Data Analysis and Runoff Estimation

Rainfall mass curve; Hyetograph; Mean rainfall depth; frequency of point rainfall; Plotting position: Estimation of missing data; Test for consistency of rainfall records: Interception; Infiltration: Factors affecting runoff, measurement techniques. rating curves and their extension methods, estimation measurement of streams velocity and discharge.

Hydrograph and Flood Analysis

Hydrograph separation; Unit hydrograph theory: Unit graph of different duration and Snyder's synthetic unit hydrograph method; Flood routing: Hydrologic reservoir routing by modified Pulse method and Goodrich method: Hydrological channel routing by Muskingum routing method: Flood frequency analysis method.

Ground Water Hydrology

Occurrence distribution and movement of ground water.

Hydrological Modelling

Introduction of basic concepts,

Suggested List of Tutorials

- Study of different types of rain gauges:
- Rainfall chart analysis.
- Double mass curve analysis.
- Rainfall average depth and probability analysis.
- Study of stage recorders and current meters.
- Peak runoff rate and runoff volume estimation.
- Hydrograph analysis.
- Unit hydrograph analysis.
- Flood routing analysis.

Suggested Text Books and References

- Subramanya, K. "Engineering Hydrology". Tata McGraw Hill. Second Edition, 1987.
- Singh. V.P. "Elementary Hydrology". Prentice Hall of India Pvt. Ltd., Third Reprint, 1994.
- Linsley. R.K., Kohler, M.A. and Paulhus, J.L.H. "Hydrology for Engineers". McGraw Hill International Book Company, Fourth Reprint, 1984.
- Raghunath. H.M. "Hydrology Principles Analysis Design". New Age International (P) Ltd .. Revised Printing, 1996.
- Chow, V.T., Maidment, D.R. and Mays, L.W. "Applied Hydrology". McGraw Hill International Editions. 1988.
- Ghosh. R.K. and Swain, S. "Practical Agricultural Engineering", Vol. I and II, Naya Prakash, Calcutta, 1993.

SOIL MECHANICS

Introduction

Engineering Properties of Soils

Water content; Unit weight of soil; Specific gravity; Void ratio; Porosity; Degree of saturation; Functional relationships; Determination of index properties; Liquid limit; Plastic limit; Shrinkage limit; Plasticity index; Particle size distribution curve.

Classification of Soils and Clay Mineralogy

Particle size classification; Textural classification; HRB classifications; Unified soil classifications; and Indian standards classification; Soil structure; Atomic and molecular bond structure of composite soils.

Soil Hydraulics

Modes of occurrence of water in soils; Stress condition in soil; Permeability; Factors affecting permeability; Laboratory and field methods of determining permeability coefficients.

Well Hydraulics; Definitions; Dupuits theory; Pumping out test; Pumping in test; Interference among wells; Seepage analysis; 2-dimensional flow; Flow nets.

Elasticity Applied to Soils

State of stress at a point; Equilibrium equations; Strain components; Stress distribution; Pressure distribution diagrams; Newmark's influence charts; Contact pressure; Principal stresses and maximum shear.

Compression and Compressibility

1-dimensional consolidation; Solution of consolidation equation; Laboratory consolidation test; 3-dimensional consolidation test; Vertical sand drain; Compaction; Field compaction methods and controls.

Strength and Stability

Shear strength; Mohr circle of stresses; Measurement of shear strength; direct shear tests; Tri-axial compression test; Unconfined compression test; vane shear test; Pore pressure parameters; Active and passive earth pressures; Stability of slopes; Taylors stability number and stability curves; Retaining walls and their stability conditions.

Bearing Capacity of Soil and Foundations

Definitions; Rankine analysis; Terzaghi analysis; General and local shear failure;

Mayerhoeff's analysis; Effect of water table on bearing capacity; Plate load test; Penetration test; Dutch cone test; types of foundations; settlement of footings; Pile foundations and their classify options; Load carrying capacity of piles; Piles in group; Vnderneammed pile foundations; Different types of well foundation.

Stabilization of Soil and Site Investigation

Introduction; Method of Stabilisation; Site exploration; Depth of exploration; Methods of site exploration; Soil samples and samplers.

Suggested List of Experiments

- Determination of water content by oven drying methods and pycnometer.
- Determination of specific gravity of soil by density bottle and pycnometer.
- Determination of grain size distribution by sieving.
- Determination of liquid limit of soil and plastic limit of soil.
- Determination of permeability by constant head test and falling head test.
- Calculation of void ratio and coefficient of volume changes by of solids methods.
- Standard proctor test.
- Determination of shear parameters by direct shear test and triaxial test.
- Determination of unconfined compression strength of soil

Suggested Text Books & References

- Murthy, V.N.S. "Soil Mechanics and Foundation Engineering". Delhi, Dhanpat Rai, 1987.
- Punmia, B.C. "Soil Mechanics and Foundation". New Delhi STD Book House, 1987
- Gopalrajan and Rao, A.S.R. "Basic and Applied Soil Mechanics", 1993.
- Bowell, S'J. "Soil Mechanics". New Delhi Wiley Eastern, 1991.

I.C. ENGINE

Introduction

Familiarization; Basic engine nomenclature; Engine classification; Two stroke and Four stroke engine; C.I. and S.I. engines and their fundamental difference; Energy flow through reciprocating engines; Reciprocating engine speed and load 'control Governing of engines and type of governors.

Thermodynamic Concepts

Energy; Work and heat; Properties; State and processes; General energy equation Perfect gas law; Flow and non flow processes; P-v and T-s diagrams.

Air Cycles

Carnot cycle; Otto cycle; diesel cycle; Dual combustion cycle, their thermal efficiency and mean effective pressure; Comparison of cycles based on same compression ratio and heat input; Constt maximum press and heat input and same maximum press and temperature.

Carburation

Chemically correct air fuel ratio; Principle of simple carburettor; Engine air- fuel requirement for idling; Cruising and high power.

Ignition System

Ignition system requirements; Battery and magneto systems; Ignition timing; Spark plug.

Super Charging

Introduction; Objective of super charging; Thermodynamic cycle with supercharging; Super charging of S.I. engines; Super charging of C.I. engines; Effect of supercharging; Method of super charging; Turbo charging.

Engine Cooling

Introduction; Need for engine cooling; Variation of gas temperature; Heat transfer; Piston and cylinder temperatures; Heat rejected to coolant; Properties of cooling systems.

Engine Friction and Lubrication.

Total engine friction; Determination of engine friction; Lubrication; Lubrication principles; Properties of Lubricating Oils; Additives.

Performance and Testing of S.I. Engines

General combustion theory; Normal combustion and flame front propagation; Factors effecting flame speed; Rate of pressure rise; Abnormal combustion; Heat balance; Air consumption of S.I. engines; Volumetric efficiency torque and indicated power; performance curves.

Performance and Testing of C.I. Engines

Combustion in C.I. engine; Ignition delay; Factors affecting ignition delay; Combustion knock in C.I. engines; Air consumption in C.I. engine; variables effecting C.I., engine performance.

Suggested List of Experiments

- Study of the I.e. engine models.

- Load test on a petrol engine.
- Load test on a diesel engine.
- Morse test on heat balance in a multi cylinder engine.
- Determination of volumetric efficiency on an I.C. engine.
- Determination of S.I. and C.I. fuel thermal efficiency.
- Determination of A-F ratio of engine.
- Determination of fuel and lubricant properties.
- Engine exhaust testing for quality emission.
- Determination of engine noise and vibration.

Suggested Text Books and References

- Mathur, M.L. and Sharma, "P. I.C. Engine". Dhanpat Rai Company, 1969.
- Ballary, P.L. "Internal Combustion Engine". Khanna Publishers, Delhi, 1992.
- Purohit, R.K. "Thermal Engineering". Scientific Publishers, Jodhpur, 1997.
- Obert, E.F. "Internal Combustion Engines and Air Pollution. Intext", Harper and Raw Publishers, New York, 1973.
- Paul, W., Gill. James, H. Smith (Jr.) and Eugene, J. Ziurys. "Fundamentals of I.C. Engines". Oxford and IBH Publishing Company Pvt. Ltd., 1967.

KINEMATICS AND DYNAMICS

Introduction

Objective of the course and its application in design of various moving parts in mechanical systems as well as agricultural machinery.

Kinematics

Definition of mechanisms; Kinematic link; Grubler's criterion and motion conversion; Inversion of quadric cycle chain; Slider crank chain and double slider crank chain; Analysis of displacement, velocity and acceleration; Method of instantaneous centre; Arnhold-Kenedy theorem; Method of relative velocity and relative acceleration; Coriolis component; Graphic method of analysis; Geometric methods; Method of complex vectors; Lagrangian method; Newton Raphson algorithm for position analysis; Analysis of four bar chains; Grashof condition and dead points; Synthesis of linkages; Graphic synthesis; Fraudenstein equation; Precision points.

Balancing

Balancing definition; Static and dynamic balancing; Balancing of rotating masses; Primary and secondary forces their balancing in single and multi cylinder inline engines; Equivalent mass of connecting rod; Balancing of rotary machinery; Critical speed of shaft; Introduction to Longitudinal transfers and tortional vibration; Turning moment diagram

for a multicylinder engine; Fluctuation of energy; Coefficient of fluctuation of energy and fluctuation of speed; Fly wheel; Energy stored in a flywheel; Dimensions of the flywheel rim.

Agricultural Machinery

Mechanism used in crop production and processing machines; fore bar linkage used in tractor hitch system; Reciprocating cutter bar mower; Post hole digger; Spray boom folding systems; Seed drill lifting and lowering; Hay baler and binder; Safety spring in cultivator; Feed mechanisms in filling and packaging machinery; Agitator cleaning and grading machinery.

Gears and Gear Trains

Classification of gears; Law of gearings; Forms of teeth; Cycloidal teeth; Involute teeth; Length of path of contact; Types of gear trains; Simple gear trains; Compound gear trains; Reverted gear train; Epicyclic gear train; Velocity ratio of epicyclic gear train; Compound epicyclic gear train; Torques in epicyclic gear train,

Cam

Classification of cams and followers; Cams with knife edge followers; Roller followers and flat faced followers; Cams with programmed motion and fixed contour.

Governors

Types of governors; Tractor governors; Terms related to governors; Governor regular sensitivity; Special droop and hunting.

Brakes and Dynamometers

Types of brakes and their use; Dynamometers types and uses.

Clutches and Bearings

Friction clutches; Disc or cone clutches; Uniform wear theory and uniform pressure theory; Cone clutches; Centrifugal clutches; Ball and Roller bearings; Rolling resistance; Journal bearings.

Suggested Text Books and References

- Ghosh, Amitabh and Mallick, A.K. "Theory of Mechanisms and Machines". Second Edition, Affiliated East- West Press Pvt. Ltd., New Delhi, 1988.
- Krutz, G., Thompson, L. and Claar, P. "Design of Agriculture Machinery".
- Green, W.G. "Theory of Machines". Asian Edition, Blackie and Sons (India) Ltd., Calcutta, 1961.

- Bevan, Thomas, "Theory of Machines". Indian Edition, CVS Publishers and Distributors, Delhi, 1984.
- Hartenberg, R.S. and Denavit, J. "Kinematics Synthesis of Linkages". Me Graw Hill Book Co., 1964.
- Erdman, A.G. and Sandor, G.N. "Mechanisms Design Analysis and Synthesis". Prentice Hall of India Pvt. Ltd., New Delhi, 1984.
- Shigley. J.E. "Kinematic Analysis of Mechanisms". Second Edition. McGraw Hill Book Co., 1969.

ELECTRICAL MACHINES

D.C. Machines

Constructional features and principles of operation of shunt, series and compound generators and motors including EMF equation and armature reaction; performance characteristics of generators and motors; starting, speed control and braking of motors. 2-quadrant and 4quadrant operation of motors; choice of D.C. motors for different applications; losses and efficiency.

Transformers

Construction, EMF equation, principle of operation, phasor diagram on no-load, effect of load, equivalent circuit, voltage regulation, losses and efficiency, tests on transformer, prediction of efficiency and regulation, auto-transformers, instrument transformers, three - phase transformers,

Induction Motors

Rotating magnetic fields, principle of operation, equivalent circuit, torque-slip characteristic. starters for cage and wound rotor type induction motors, speed control and braking, single phase induction motors and methods of starting.

Synchronous Machines

Construction, e.m.f. equation, effect of pitch and distribution, armature reaction and determination of regulation of synchronous generators; principle of motor operation, effect of excitation on line currents (V-curves), method of synchronisation; typical applications of A.C. motors in industry.

Laboratory

Study of d.c. and a.c. machine constructional features and connections

Study of various types of starters for d.c. and a.c. motors

Saturation characteristics of a d.c. machine and load test on d.c. shunt generator.

Determination of performance characteristics of a shunt motor.

Speed control of a d.c. shunt motor.

Performance characteristics of d.c. compound motors.

Open circuit (O.C.), Short circuit (S.C.) and load test on a single phase transformer

Regulation of alternators by O.C. and S.C. tests

Speed control of 3-phase induction motors.

Determination of V-curve of synchronous motors.

Performance characteristics on-phase induction motors. ."

Performance characteristics of I-phase induction motors including capacitor start/run 1-phase motors.

Instrument/Equipment

Coupled d.c. generator/induction motor set, voltmeters, ammeters, loading rheostats, DPST switches, Voltmeters (MC/MI), ammeter (MC/MI), wattmeters, D.C. shunt motor (220 V/ 110 V, 1200 rpm, 3 KW), rheostats, tachometers, 3-point starter, Single phase transformer (3 KV A/5 KV A, 220 V/110 V, 50 Hz), single phase variac (220 V, 50 Hz), current transformer, star-delta and rotor resistance starters, Coupled d.c. motor - alternator with synchronising unit, Single phase and three phase induction motors (220 V/400 V, 0.5-5 KW) capacitors.

Suggested Text Books & References

- Hughes, Edward "Electrical Technology", Addison Wesley Longman Ltd., 1995.
- Nagrath I.J. and Kothari, D.P. "Electrical Machines", Tata McGraw Hill Publishing Co.Ltd., 1992.
- Cotton, H. "Advanced Electrical Technology", Wheeler and Co., 1995.
- Fitzgerald, Kingsley, Kusko, "Dumas - Electrical Machines", McGraw Hill Pub., 4th Ed., 1994
- Kosow, I.L. "Electrical Machinery and Transformers", Prentice Hall of India, 4th Ed., 1992.
- Parker Smith, S. "Electrical Engineering Problems", CBS, New Delhi. 1995.

CROP PRODUCTION

Introduction

Concepts in crop production; geographical distribution of crops and cropping systems; economic importance.

Crop Classification

Cereals, pulses, oilseeds, fiber crops, forage crops, medicinal and aromatic crops and horticultural crops.

Cropping Systems for Major Agro-Ecological Regions

Detailed descriptions of rice based cropping systems, sugarcane based cropping systems, cotton based cropping systems, pulses and oilseeds based cropping systems, their suitability in different agro-ecological regions.

Crop Eco Systems

Irrigated and rain fed eco systems, strategies of crop production in tropical and sub-tropical regions in the two major eco systems under different crops.

Modern Techniques of Raising Field and Horticultural Crops

Techniques of nursery raising, method of planting, fertilization, irrigation scheduling, weed control, and other practices to optimize yield, economic evaluations.

Tillage Practices and Soil Management

Conventional tillage practices their effects and shortcomings, modern tillage practices and their advantages; optimum tillage with different tillage implements and their effect on soil properties, soil changes due to long term effect of certain tillage system.

Seed and Seeding Practices

Quality of seed, seed rate, seed treatment, seeding methods, modern seeding techniques.

Scheduling of Irrigation and Fertilizers

Irrigation schedules for different crops in different soils and agro-climatic regions, ferti-irrigations, irrigation methods.

Plant Protection Measures

Pesticides types of weedicides and insecticides available to control different weed flora, pests and diseases and their mode of action; time of application and symptoms,

Harvest and Post Harvest Operations

Method of harvesting; modern implements their efficiency and economics, losses during harvesting and threshing and storage; threshing methods and modern threshing techniques, and economics.

Dry Farming Principles and Practices

Water stress in relation to crop productivity; concept of crop productivity and plant type for dry farming areas; dry farming practices; crop improvement for efficient water use and efficient water utilization practices.

Crop Growth Assessment and Modelling

Crop, growth parameters and their measurements, models for estimating crop growth and yield and their usefulness.

Suggested List of Experiments

- Identification and acquaintance with seeds, plants, weeds and agro-chemicals.
- Testing of germination, viability and vigour of seeds.
- Estimation of agrochemicals for field applications.
- Determination of tillage requirement for field preparations.
- Hydroponics.
- Seeding and planting techniques and assessment of stand and establishment of field crops.
- Irrigation water measurement techniques.
- Biometric observations on growth, yield and yield attributes.
- Measurement of leaf area index.
- Determination of chlorophyll content in leaf.
- Estimation of oil in different oilseed crops.
- Determination of N : P : K in crops.

Suggested Text Books and References.

- Singh, Chidda "Modern technique of raising of field crops". Oxford and IBH Publishing Company Pvt. Ltd., 1994.
- Agarwal R.L. "Seed Technology". Oxford and IBH Publishing Company Pvt. Ltd., 1990.
- Chalam, G.B., Singh Amir and Douglas. J.E. "Seed Testing Manual". ICAR and NSC, 1967.
- Rao, V.S. "Principles of Weed Science". Oxford and IBH Publishing Company Pvt. Ltd., 1983.
- Singh, R.P., Reddy, P.S. and Kiresur, V.(eds.). "Efficient Management of Dryland Crops in India". Indian Society of Oilseed Research, DOR Rajendra Nagar, Hyderabad, 1997.

- Prihar and Sandhu. "Irrigation of Field Crops - Principles and Practices". ICAR, 1994.

MANAGEMENT SCIENCE

Basic Concepts and Functions of Management: Planning Nature, Purpose and Objectives of Planning, Organizing: nature and Purpose, Authority and Responsibility, Staff bug, Supply of Human Resources, Performance Appraisal, Controlling: System and Process of Controlling, Control Techniques.

Human Resource Management: Nature and Scope of Human Resource Planning, Training and Development, Recruitment and Selection, Career Growth, Grievances, Motivation and its types, Need for Motivation, Reward and Punishment, Models for Motivation, Leaders: Kind of Leaders, leadership styles, Roles and Function of Leaders, Conflict Management, Kinds and Cause of Conflict, Settlement of Conflict, Group and Team working, Organizational Design and Development.

Marketing Management: Marketing Environment: Consumer Markets and Buyer Behaviour, Marketing Mix, Advertising and Sales Promotion, Channels of Distribution.

Financial Management and Accounting Concepts: Book Keeping, Financial Statement Analysis, Financial Ratios, Capital Budgeting, Break-Even Analysis.

Production/ Operation Management: Planning and Design of Production and Operation Systems, Facilities Planning, Location, Layout and Movement of Materials, Materials Management and Inventory Control, Maintenance management, PERT & CPM.

Management Information System: Role of information in decision making, Information system planning, Design and Implementation, Evaluation and Effectiveness of Information System.

Statistical Quality Control, TQM and ISO Certification

Social and Ethical Issues in Management: Ethics in management, Social Factors, Unfair and Restrictive Trade Practices.

Strategic and Technology Management: Need, Nature, Scope and Strategy, SWOT analysis, value and concepts

Suggested Text Books & References

- Philip Kotler, " Marketing Management", Prentice Hall of India 1997.
- Fred Luthans, " Human Resource Management", McGraw Hill, Inc. 1997.
- Stephen P. Robbins, "Organizational Behaviour Concepts, Controversies and

- Applications", Prentice Hall, Englewood, Cliffs, New Jersey, 1989.
- Khan M.Y. and Jain, P.K" Financial Management", Tata McGraw Hill, 1997.
- Porter, Michael, " Competitive Advantage", The Free Press.1985
- Porter, Michael," Competitive Strategy", The Free Press, 1985
- Bhusan, Y.K "Fundamentals of Business Organisation and Management", S.Chand and sons,1998.
- Ahuja, KK" Industrial Management", Khanna Publishers, 1998.

SURVEYING AND LEVELLING

Introduction

Definition, objects, classification, principles of surveying; Location of a point; organization of field and office work; Conventional signs; Surveying instruments, their care and adjustments; Principles of reversal.

Linear Measurements (Chain Surveying)

Types of chains and tapes; arrows, pegs, ranging rods, plumb bob; Direct and reciprocal ranging; Offsets; Selection of stations; Base line, tie line and check line; Errors in chaining and corrections applied; Obstacles in chaining; Tape corrections

Angular Measurements

The Compass: Component parts and their use; Reference meridians; Dip and declination; Local attraction and its elimination; Closing error.

The Theodolite: Classification and use; Fundamental lines; Theodolite adjustments; Measurement of horizontal angles, vertical angles, bearings etc. using different methods.

Traversing

Traversing by compass and theodolite; Checks and plotting; Closing error and its adjustment; Omitted measurements.

Levelling

Definitions; Levelling instruments, different levels and staves; Adjustment of levels; Booking and reducing the levels; Curvature and refraction; Corrections; Distance to the visible horizon; Sensitiveness of bubble tube; Errors and difficulties in levelling; Reciprocal levelling; Plotting of profiles.

Tacheometry

Definitions; Principles; Instrument constants; Stadia system; Subtense and tangential systems; Range finders; Errors and precision.

Contouring

Definitions; Contour interval and horizontal equivalent; Characteristics of contour lines; Direct and indirect methods of contouring; Use of contour maps.

Plane Table Surveying

Instruments used; Working principles and operation; Methods of plane tabling; Advantages and disadvantages.

Minor Instruments

Abney level; Ceylon Ghat Tracer; Pentagraph; Planimeter.

Suggested List of Experiments

- Construction and use of instruments required for chain surveying; offsets and recording in field book.
- Ranging out survey lines; chain angle measurements and recording in field book.
- Chain triangulation and preparation of map of a small area.
- Measurement of angles by prismatic compass for exercise No.3.
- Study and use of various components of a transit theodolite; measurements of horizontal angle, vertical angle and bearings.
 - a) To determine the height of an inaccessible tall building.
 - b) Use of theodolite as a level.
- Study of component parts of a level and levelling staff; temporary adjustment and recording of a few levels in the field book.
 - a) Fly levelling.
 - b) Reciprocal levelling.
- Longitudinal and cross sections along a given route.
 - c) Determination of Tacheometric constants.
 - d) Determination of Gradient between two points using tacheometric methods.
- Preparation of contour map of a small area.
- Setting up of plane table and offsetting.
- Plane table surveying.

- Use of planimeter for determining the area of irregular figure.

Suggested Text Books and References

- Kanetkar, J.P. and Kulkarni. "Surveying and Levelling", Part I and II, Pune, Vidyarthee Griha Prakashan, 1985.
- Punmia, B.C. "Surveying and Field Work", Vol. I and II, New Delhi, Laxmi Publications, 1994.
- Duggal, S.K. "Surveying", Vol. I and II. McGraw, 1994.

AGRICULTURAL ENGINEERING STRUCTURES AND RURAL ENGINEERING

Introduction

Scope of the subject; Different types of farm buildings rural roads, water supply and sanitation.

Farmstead Planning

Site selection; Building arrangement; Yard lighting; Wind control.

Ventilation

Ventilation requirement; Physiological consideration; Fans and Blowers; Fan locations; Air inlets; Exhaust versus pressure systems.

Housing of Dairy Cattle

Planning and designing dairy barns, stall barns and loose houses; milking parlor; labour efficiency and waste management.

Poultry Housing

Poultry housing requirements; common types of poultry houses and their planning.

Silos and Hay Storages

Silo-requirement; Types of silo, over ground, underground and others; Design of silos; Hay storage in covered and open spaces.

Machinery Sheds Farm Shops and Fencing

Machinery sheds; Site selection; Types and shapes of building; Space requirements; Farm shops, building requirement and space requirement; Fencing, types of fences, fence posts, different types of fence construction and specification.

Green Houses

Types; Functional design; Structural material and design; Orientation, ventilation, cooling and types of cladding material and water management

Rural Roads

Survey and planning; Geometrical design; Pavement design; Construction and maintenance; Typical rural culverts of different sizes, their hydraulic and structural design and construction.

Estimating and Costing

Methods of material and cost estimation of farm buildings and other structures; rural roads

Farm Trusses

Types; King post truss, queen post truss and trusses for workshops and other conditions and their design.

Farm Water Supply and Sewage Disposal

Sources of water supply: Estimation of quantity for different consumption; Capacity requirements of storage tanks; distribution systems: Pipe network analysis, Design of septic tanks and sanitary structures

Suggested List of Experiments

- Layout of farmstead for a given requirement.
- Design of stall barn for a given number of cows.
- Design of loose housing and milk parlours.
- Study of dairy barns, poultry house, biogas plant existing in nearby locations.
- Design of ventilation system for dairy barns.
- Design of machinery and equipment shed and workshops.
- Design of septic tank and absorption field.
- Design of rural/farm roads and culverts.
- Estimating cost of a building and other structures.

Suggested Text Books and References

- Barre, H.J. and Sammet, L.L. "Farm Structures". John Wiley and Sons Inc. 1950."
- Neubaur, L. W. and Walker, H.B. "Farm Buildings Design". Prentice Hall Inc., 1961.-
- Khanna, S.K. and Justo, C.E.G. "Highway Engineering". Nemchand and Bros., Roorkee, India.
- Dutta, B.N. "Estimating and Costing in Civil Engineering Theory and Practice". S. Dutta and Co.
- Bazirani, V.N. and Ratwani, M.M. "Steel Structures". Khanna Publishers, Delhi, 1981.
- Justo, C.E.G. and Khanna, S.K. "Highway Engineering". Nemchand and Bros., Roorkee, India (Revised).

POST HARVEST ENGINEERING

Engineering Properties of food materials

Physical, mechanical, thermal, rheological, electrical and physico-chemical Properties of various food materials

Psychometric Properties of air-water-vapour Mixture

Humidity, Adiabatic saturation, humidity charts, wet bulb temperature, psychometric lines, humidification operations, gas-liquid contents, gas laws and their application in determining various psychometric properties of air-water-vapour mixture.

Cleaning and Grading

Screening & types of screens, motions of screens, effectiveness of screens, Air-screen cleaners and different types of graders for cereals, pulses & oil seed crops.

Drying Characteristics of food Materials

Theory of grain drying; methods of grain drying for cereals, pulses & oil seeds crops and their design, selection and testing.

Milling and Size Reduction Operation

Size reduction and particle size distribution of comminuted products, Performance evaluation by commercial and modern mills for cereals, pulses and oilseeds, energy requirements in size reduction operation, and sugar crop crushing, extraction recovery, and processing of Jaggery.

Storage and Materials Handling

Direct and indirect type of damages, sources of infestation, traditional and modern types of storage structures vertical, horizontal and underground storages, storage structure designs, storage of agricultural perishables controlled and modified atmosphere storages; Horizontal and vertical conveyors, screw conveyors their designs and testing.

Agricultural Waste and By-Products Utilization

Characteristics of agriculture wastes such as wheat straw, paddy straw, maize cobs, paddy husk, by-products of cereals, pulse and oil mills, fuels, fibre and feeds. Biogas production, Building materials, Gasification and other Chemical and Biochemical Transformations.

Suggested List of Practical's

- Determination of moisture by direct and indirect methods
- Size reduction and determination of energy required in size reduction operation
- Determination of milling quality of paddy
- Determination of milling quality of wheat
- Determination of milling quality of pulses
- Sieve analysis of grain milled products
- Parboiling of paddy
- Performance evaluation of a seed cleaner and grader
- Determination of shelling efficiency of a maize dehusker.
- Performance of a rice polisher
- Evaluation of thermal efficiency and heat utilisation factor in a grain dryer
- Performance of an oil expeller
- Calorific value of biofuels
- 14. Thermal and gravimetric analysis and differential thermal analysis of biomass
- Determination of rheological properties of food grains
- Determination of drying characteristics of grain

Suggested Text Books & References

- Chakraverty, A. "Post Harvest Technology of Cereals, Pulses and Oil Seeds".3rd Ed., Oxford & IBR 1988
- Sahai, K.M. and Singh, K.K. "Unit operation in Agricultural Engineering", Vikas Publishing House Pvt. Ltd" 1994
- Saxena R.P. Sansadhan (Hindi), "Directorate of Publication & Translation", G.B Pant University, Pantnagar, 1984
- McCabe, W.L. and Smith, J.C. "Unit Operations in Chemical. Engineering", Tata McGraw Hill, 1976
- Henderson, S.M, and Perry, R.A "Agricultural Process Engineering", John Wiley and Son, 1955
- Bakker-Arkema, F.W. "Drying of Cereal Crops". Lyall book, 1957

SOIL AND WATER CONSERVATION ENGINEERING

Introduction

Soil erosion, causes, types and its major effects.

Soil Erosion

Water and wind erosion; Forms of water erosion; Soil loss estimation (USLE).

Erosion Control Measures and Structures

Land use capability classification; Agronomical measures - contour map cropping, strip cropping, mulching; Mechanical or engineering measures - layout and design of bench terraces, broad base terraces, contour bund and graded bunds.

Wind Erosion and Control

Mechanics of wind erosion, soil loss estimation, wind erosion control measures - vegetative cultural and mechanical measures, wind breaks and shelter belts, sand dunes and their stabilization.

Grassed Water Ways

Design of grassed waterways.

Gully and Ravine Reclamation

Gully control structures temporary and permanent; Design details of permanent gully control structures drop spillway and drop inlet spillway

Farm Pond and Earthen Embankment

General description of earthen embankments, earth fill and rock fill dams, classification of earthing dams, design of water harvesting structures.

Watershed Management

Its objectives, preparation of watershed management and development plan.

Suggested Text Books and References

- Schwab, G.O., Frevert, R.K., Edminister, T.W. and Barnes, K.K. "Soil and Water Conservation Engineering", John Wiley and Sons, 1989.
- Murthy, V.V.N. "Land and Water Management Engineering", Kalyani Publishers,

- 1985.
- Singh. G. "Manual of Soil and Water Conservation Practice in India". Central Soil and Water Conservation Research and Training Institute, Dehradun, 1995.
 - United States, "Department of the Interior, Design of Small Dams". Oxford and IBH Publishing Com. 1979.
 - Ghosh, R.K. and Swain, S. "Practical Agricultural Engineering". Vol. I and II, Naya Prokash, Calcutta, 1993.
 - Suresh, R. "Soil and Water Conservation Engineering", Standard Publishers Distributors. 1997.

BUILDING MATERIALS AND STRUCTURAL DESIGN

Building materials

Properties and classification of conventional building materials, like bricks, lime, cement, sand, coarse aggregates etc. Classification of seasoning and preservation of timbers. use of materials like plywood, asbestos, plastic and PVC, glass, aluminium etc. 111 buildings and sheds. Use of flyash and flyash products in construction and waterproofing materials for concrete.

Structural design

Concept of determinate and indeterminate structures, moments of inertia of sections, bending moment. and shear force diagrams and design of steel and concrete beams. design of steel and R.C.C. columns and column footings. Design of roof slabs. roof trusses. portions and bracings for sheds, concept of ferro-cement structures like grain containers used in agricultural work. Structural details of underground and overhead liquid containers, silos, cold storage structures and open web structures.

Concept of detailed and abstract estimates

Introduction to departmental schedules, estimation procedure for buildings. sheds and roads

Laboratory Design Assignments

Laboratory Work

Mixing of concrete by mixers and casting of cubes for quality control.

Slump test of concrete

Compression of cubes

Vicats test for setting time of cement

Ultrasonic tests for concrete strength

Use of electrical strain gauges

Design Assignments

Design of simply supported R.C.C. and steel beams

Design of one-way and two-way R.C.C. slabs

Design of columns R.C.C. and steel

Design of shallow R.C.C. foundations of columns

Design of Fink trusses, purlins and bracings for sheds

Detail and abstract estimate of a small building using schedule

PUMP ENGINEERING AND HYDRAULIC CONTROL

Introduction

Pumps and indigenous water lifting devices; Human power devices; Animal power devices.

Classification of Pumps

Centrifugal pumps; Turbine pumps; Propeller pumps; Positive displacement pumps: Air lift and Jet pumps.

Reciprocating Pumps

Single acting pumps, working principle; Double acting pumps, working principles; Air vessels volume, design and installation.

Centrifugal Pumps

Working of centrifugal pumps; Classification; Head; Casing; Flow direction; Entrances; Specific speed equation; Specific speed in terms of wheel dimensions; Characteristics curves: Effect of viscosity and performance curves; Pump efficiencies; Model tests; Design of Impellers.

Cavitation

Suction head or net positive suction head; required and available head; factors effecting cavitation: Cavitation parameters.

Selection of Centrifugal Pumps

Pumping arrangements and economic considerations.

Working Principles of Various Pumps

Working principles of jet pumps; Axial flow pumps; Air lift pumps; Submersible pumps; Mixed flow pumps and turbine pumps: Design of Francis type impeller and mixed flow Impellers.

Pump Troubles Causes and Remedies

Working and Design of Hydraulic Ram for Different Stream Flow and lift conditions, Construction, Types, Working and Installation of Windmills for different wind velocity conditions

Hydraulic systems: Hydrostatic and Hydrokinetic system: Rotary positive displacement pumps for hydrostatic system; Constant and variable delivery pump: External and internal type gear pumps; Screw Pumps; Vane pump.

Suggested List of Experiments

- Study of Archimedian Screw and other indigenous water lifting devices.
- Study of radial flow and mixed flow centrifugal pumps.
- Study of multistage centrifugal pumps, turbine, propeller and other pumps . . .
- Installation of centrifugal pump at a given location.
- Testing of a centrifugal pumps.
- Study of single acting and double acting reciprocating pumps and testing.
- Study of cavitation in centrifugal pumps.
- Study of performance evaluation of hydraulic ram.
- Performance evaluation of conventional bucket pump.
- Performance evaluation of deep well bucket pump.
- Study of jet pumps.
- Study and testing of gear pumps.

Suggested Text Books and References

- Church, A.M. and Lal, Jagdish "Centrifugal Pumps and Blowers". Metropolitan Book Company, 1991.
- Lal, Jagdish "Hydraulic Machines". Metropolitan Book Company. 1961.
- Michael, A.M. and Khepar, S.D. "Well and Pump Engineering 1980".

- Stepanoff, AJ. "Flow Pumps Design and Application". John Wiley and Sons, 1998.

GROUND WATER AND WELL ENGINEERING

Introduction

Scope, utilization of ground water sources and different ground water structures.

Aquifers

Types and characteristics occurrence and movement of ground water: Evaluation of aquifer properties; Darcy's law; Field and laboratory measurement of saturated and unsaturated coefficient of permeability.

Ground water investigation and Well Hydraulics

Ground water exploration and test drilling; Classification of wells: Steady and unsteady state flow into wells in confined and unconfined aquifers: Methods of estimating aquifer parameters in confined wells in unsteady state conditions; Multiple well system: Well characteristics and efficiency.

Ground Water Recharge

Ground water recharge; Artificial ground water recharge techniques i.e. through pits, rivers and canals.

Ground Water Potential

Different components of ground water balance equation; Method of estimation of safe yield: Determining ground water potential for a district and a given region;

Well Drilling and Construction Methods

Method of construction of shallow wells and deep wells; Manual method, percussion method, hydraulic rotary, reverse circulatory and other methods; Test hole and well logs.

Design of Tubewells

Design of well housing and well screen; Selection and installation of well screens; Criteria and methods of gravel packing; Methods of well development Well testing; Selection and Installation of pumps; Sanitation and well protection.

Suggested List of Experiments

- Use of resistivity meter for studying water bearing formation.

- Well log analysis for gravel and well screen design.
- Measurement of discharge drawdown behaviour in pumped well.
- Evaluation of aquifer properties using pumping test method of Theis.
- Evaluation of aquifer properties by Cooper-Jacob, Chow and Theis's Recovery method.
- Well design under confined and unconfined flow conditions.
- Testing of well screen under confined conditions.
- Estimating ground water potential of an area from available data.
- Computation of well flow for multiple well system and other simple hydraulic boundaries.

Suggested Text Books and References

- Raghunath, H.M. "Ground Water". Wiley Eastern Limited, 1990.
- Todd, D.K. "Ground Water Hydrology". John Wiley and Sons, New York, 1980.
- Michael, A.M. "Irrigation Theory and Practice". Vikas Publishing House. New Delhi. 1998.

IRRIGATION ENGINEERING

Introduction

Water Resource Development and Utilization in India; Surface water resources. ground water resources, India's water budget, utilization of water resources, factors a fleeting water utilization. major river basins of India. history and development of Irrigation in India, classification of irrigation projects, canal network, water distribution pattern, system of levying irrigation charges.

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- Study of different type of water emission devices for drip and sprinkler systems.
- Study of different of types of filters and for tigation equipments.
- Field visit to see layout of surface irrigation, sprinkler and drip irrigation on a farm.
- Measurement of advance and recession in surface irrigation and estimation of irrigation efficiency.
- Operation of sprinkler irrigation system determination of discharge rate and uniformity coefficient.
- Study of drip irrigation system measurement of discharge rate through emitters and distribution pattern.

Suggested Text Books and References

- Michael, A.M. "Irrigation Theory and Practice", New Delhi, Vikas Publications, 1978.

- Majumdar, S.K. "Irrigation Engineering", New Delhi, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Schwab, G.O., Frevert, R.K., Edminister, T.W. and Barnes, K.K. "Soil and Water Conservation Engineering". John Wiley and Sons Inc. New York.
- Lal R. "Irrigation Hydraulics", Allahabad, Saroj Prakashan, 1978.
- Zimmerman, Z.E. "Irrigation", New York, Wiley International, 1966.
- Nakayama, F.S. and Bucks D.A. (editor). 1986. "Drip Irrigation for Crop Production, Design. Operation and Management". Elsevier, Amsterdam.
- Keller. Jack. 1990. "Sprinkler and Trickler Irrigation". Van Nostrand Reinhold, 115, Fifth Avenue, New York.

FARM MACHINERY

Introduction

Present Status and Scope, bottle necks of farm mechanization and mechanization policy.

Primary Tillage Equipment

Mould board plough animal and power operated, types and construction, working principles. Accessories of M.B. plough forces acting on mould board bottom. Disc ploughs, types and construction, soil reaction and draft of disk ploughs, and special tillage implements such as rotavators sub-soiler, paddy puddler.

Secondary Tillage Equipment

Disc harrow types and construction. Selection of disk harrow. Forces acting on disk harrows and then analysis.

Dynamic Soil Properties

Dynamic soil properties affecting soil tool interaction. Atterberg, soil and metal friction

Forces Acting on Tillage Tool

Force analysis of tillage tools and their measurement. Types of dynamometer-spring hydraulic, eddy current and strain gauge types.

Implements Hitching

Virtual and real hitching for single point, single axis and double hitch implements.

Yokes and harness for draught animals and mechanics of hitching.

Sowing Planting and Fertilizer Application Equipment

Construction and working principles of seeding, planting and fertilizer application equipment seed and fertilizer metering devices, furrow openers and covering devices calibration, field adjustment and operations, paddy and potato planters, sugarcane planters.

Interculture Equipment

Cultivators, sweeps and shovels, types and uses, rotary hoes, noddors, classification of weeders according to power sources.

Plant Protection

Plant protection equipments, types construction and working principle. Selection of equipment for spraying and dusting characteristics of equipment. Safety in use of sprayers and dusters.

Harvesting and Threshing

Classification, construction and working principles of reapers mowers, combine harvesters and power threshers.

Specialized Crop Equipment

Equipment for maize, cotton, sugarcane, root crops and horticultural crops.

Selection of Farm Machinery

Performance evaluation, Selection, cost analysis and management of farm equipment.

Ergonomics of Farm Machinery

Ergonomics studies and safety of Farm Machinery & Equipment.

Suggested List of Practicals

- To study different farm operations and familiarization with farm machines and equipment.
- Studies on different animal and tractor drawn mould board ploughs and their evaluation.
- Studies on different type of disc ploughs and their evaluation.
- Studies on blade, drag and power harrows.
- To study different type of harrows.
- To study different type of sub-soiling equipment.

- To study different type of seed drills and planters and their evaluation.
- To study different types of mechanical weed control equipment.
- To study different types of seed and fertilizer application mechanism and broadcasting machines.
- To study working of mower and reapers.
- To study working of different systems of a combine harvesters and their evaluation.
- To study different types of threshers.
- To study working of different plant protection equipment.
- To study paddy cultivation machineries.
- To study potato and sugarcane cultivating machineries.

Suggested Text Books & References

- Roy Bainer, Kepner R.A. and Berger, E.L. "Principles of Farm Machinery", John Wiley and Sons, 3rd Ed., 1978.
- Smith. H.P. and Pearson, "Farm Machinery and Equipment", Tata McGraw Hill Pub. Co. Ltd.,1964.
- Richey. "Hand Book of Agricultural Engineering".
- Makra, C.P. "Farm Machines and Equipment".
- Lal, Radhey and Dutta, A.C. "Agricultural Engineering through solved examples".
- Gill William, R. and Glen.E. Vandenberg, "Soil Dynamics in Tillage and Traction Agricultural Handbook", Vo1.316, Agricultural Research Service, USDA, 1993.
- Srivastava, A.K. Carroll E. Georing and Roger P.Rohrbach "Engineering Principles of Agricultural Machinery", ASAE Publication, 1993.

REFRIGERATION AND AIR CONDITIONING

Introduction

Review of basic laws of thermodynamics; Method for production of cold; Reversed Carnot cycle; Carnot; Refrigeration and heat pumps.

Mechanical Vapour Compression Refrigeration

Simple vapour compression cycle; Comparison with reversed cannot cycle; Standard rating cycle and effect of operating conditions; Evaporator pressure; Condenser pressure; Suction vapour superheat and liquid subcooling on cycle performance; Actual cycle.

Properties of Refrigerants

Designation of refrigerants; characteristics; Thermodynamic physical and chemical requirements.

Multistage and Multieaporator Systems Cascade systems; Ice manufacture.

Compressors

Type of compression processes: Volumetric efficiency; Principle dimensions; Performance characteristics and performance of reciprocating compressors.

Expansion Valves

Construction and working of automatic and thermostatic expansion valves.

Evaporators

Flooded and dry evaporators; Mechanism of cool boiling in evaporators; Flow boiling in evaporators.

Condensers

Air cooled and water cooled condensers; Evaporative condensers.

Vapour Absorption System of Refrigeration

Simple vapour absorption system; Physical, chemical and thermodynamic requirements of refrigerant absorbent mixtures; Modifications in simple vapour absorption system.

Air Conditioning

Psychometry; Psychometric properties of moist air; Adiabatic psychrometer chart.

Psychometric Processes

Psychometry of air conditioning processes; Air washers; Winter air conditioning; Simple air conditioning system; State and mass rate of supply air.

Design Conditions

Inside and outside design conditions; Comfort chart and effective temperature and respiration heat.

Cooling Load Calculations

Internal and system heat gains; Ventilation load; Cooling load estimate; Design of cold storages.

Transmission and Distribution of Air

Room air distribution; Total static and velocity pressure; Friction and dynamic losses in

ducts.

Suggested List of Experiments

- Study of various types of compressors.
- Study of household refrigerator and window air conditioner.
- Determination of volumetric efficiency of a reciprocating compressor.
- Determination of coefficient of performance of a vapour compression, refrigeration system and absorption system.
- Determination of pull down characteristics of a cold storage.
- Studies on humidification and dehumidification.
- Calibration of flow meters.
- Determination of range approach and efficiency of a cooling tower.
- Determination of efficiency of an evaporative cooler.
- Determination of freezing time of food products.
- Determination of heat transfer coefficient inside a cold storage or refrigerator.
- Determination of thermal conductivity of various insulating materials.

Suggested Text Books and References

- Arora, C.P. "Refrigeration and Air Conditioning". Tata Me Graw Hills, 1981.
- Prasad, Manohar. "Refrigeration and Air Conditioning". Wiley Eastern, 1983.
- Dossat, R.J. "Principles of Refrigeration". Wiley Eastern, 1981.
- Stoecker, W.F. "Refrigeration and Air Conditioning". Me Graw Hill.

MACHINE DESIGN

Introduction

Principles of machine design, design procedure, design cycle.

Materials and Their Properties

Materials for construction, their classifications; Ferrous materials and their designation; Material for high temperature service; non ferrous material; Composites; Properties; Selection of materials for machine design.

Stress in Machine Parts

Stress and strain; Stress at a point; simple stress; Computation of principal stress; Stress due to axial load; Moments and torsion; Combined load; Stress due to impact, axial and bending load; Theories of failure; Factor of safety.

Design against variable load; endurance limits and fatigue strength; S-N diagram;

Soderberg and Goodman criteria; Modified Goodman diagram; Design against combined fatigue loading.

Shaft Design

Introduction: Shaft material; Causes of failure in shaft; Method of manufacturing of shaft; Stress in shaft; Design on strength; Rigidity basis; Machine vibrations; Critical speeds of shafts; ASME code equation for designing of transmissions shafts; Design of keys and splines.

Design of Joints and Fasteners

Introduction; Types of joints, their requirement; Design of joints and fastness; Rivets and Joints; Bolted joints; Cotter and Knuckle joints; Power screw; Design of levers, couplings etc.

Spring Design

Introduction; Type of springs; Stresses produced in springs; Design of spring coil and leaf springs.

Design of Pulleys, Belts and Brakes

Design of pulleys and flywheels; Design of belts, flat and V belts; Selection of belts; Design of ropes; Brakes and clutches.

Design of Gears

Introduction: Gear nomenclature; Tooth profiles; Systems of gear teeth: Gear materials; Design of straight spur gears; Design considerations; Lewis and Buckingham equations; Design of spur-helical gears; Selection of pinion teeth; Hertz contact pressure; Interference; Design of bevel gears; Properties of Bevel gears, force analysis; Design of worm gears; Design of worm gear drive; Force on worm gears; alternate method of design.

Design of Journal Bearings

Introduction to functioning and design of gearings; Hydrodynamic Lubrications: Heat generation in sliding bearings; Antifriction bearings; Selection of ball and roller bearings; Thrust ball bearings, design calculations; Dissipation of heat.

Fits and tolerance

Suggested Text Books and References

- Sharma, P.c. and Agarwal, D.K. "Machine Design".
- Pandya, N.C. and Shah, C.S. "Elements of Machine Design" Charoter Book Stall, Anand.

- Khunni, R.S. and Gupta, J.K. "Theory of Machines". Burasia Publishing House, New Delhi.
- Spotts, M.F. "Design of Machine Elements". Prentice Hall of India, 1965.
- Hall, A.S., Holowenko, Alfred and Laughlim, H.G. "Theory and Problems of Machine Design". McGraw Hills, 1982.

AGRICULTURE AND ENVIRONMENTAL ENGINEERING

Introduction

Environmental pollution; Pollution of air, water and soil; Agro based Industrial pollution into the surface and ground water; Sources of pollution; Surface and ground water pollution due to various pollutants; Factors affecting environmental degradation and their remedies.

Sources and Classification of Water Pollutants

Water resources; Origin of waste water; Types of water pollutants and their affects; Water pollution laws and standards; Waste water sampling and analysis: Physical, chemical and biological aspects of pollution of surface and ground waters; The technology of ground water pollution detection and observation; Industrial pollution of surface and ground waters: Agriculture pollution of water resources; Surface and ground water pollution due to other sources of pollutants; Engineering aspects of pollution of natural water; Water quality standards; Quality of irrigation water.

Waste Water Treatment

Basic principles of water treatment; Removal of suspended collidal and dissolved solids: Waste disposal methods; Treatment of industrial effluents: Sewage and sludge water; Biochemical and microbiological aspects of water pollution and quality control; Preventive measures to control environmental degradation: Recovery of materials from process effluents.

Solid Waste Management

Sources and classification; Public health aspects; Methods of collection; Disposal methods; Potential methods of disposal.

Suggested List of Experiments

- Study of physical characteristics of surface and ground waters.
- Determination of total dissolved solids present in the water sample.
- Determination of pH and specific conductance of water samples.
- Estimation of dissolved oxygen concentration in different water samples.

- Estimation of biochemical oxygen demand (BOD).
- Estimation of Chemical Oxygen Demand.
- Estimation of total acidity.
- Estimation of total alkalinity.
- Estimation of total hardness.
- Estimation of Sodium concentration.
- Estimation of chloride concentration.
- Estimation of Sodium absorption ratio of the water sample and its suitability for irrigation.

Suggest Text Books and References

- Krishnan, Kannan. "Fundamentals of Environmental Pollution". S. Chand and Co. Ltd.(New Delhi, 1991.
- Sharma, B.K. and Kaur, H. "Soil and Noise Pollution". Gopl Publishing House, Meerut 1994.
- Duggal, K.N. "Elements of Public Health Engineering". S. Chand and Co. Ltd., New Delhi, 1988.
- Kudesia, B.P. and Charaya, M.V. "Pesticides Pollution". Pragati Prakashan, Meerut. 1993.
- Follett, R.F. "Nitrogen Management and Ground Water Pollution". Elsevier. Tokyo, 1989.
- Fairchild, D.M. "Ground Water Quality and Agricultural Practices". Lewis Publishers, Michigan, 1987.
- Voznaya, N.F. "Chemistry of Water and Microbiology". Mir Publishers, Moscow, 1981.
- F AO. "Ground Water Pollution". FAO Irrigation and Drainage Paper 31, FAO, Rome, 1979.
- F AO. "Physical and Chemical Methods of Soil and Water Analysis". F AO Soil Bulletin, F AO Rome, 1984.
- Todd, D.K. "Ground Water Hydrology". John Wiley and Sons, New York, 1980.

TRACTORS AND POWER UNITS

Introduction

Tractor development and their classification; LC. Engines their components and construction. operating principles of 2 -stroke and 4-stroke engines, firing order and firing interval and its selection criterion, Economics of tractor utilization.

Tractor Engine Systems

Valve and valve mechanism; Air and fuel supply; cooling and lubrications system; starting and Electrical system; Transmission system-clutches, brakes, power train, transmission

gears, types of high and low gears transmission, gear box, differential and final drive mechanism. Engine governing.

Tractor Power Outlets and Tractor Controls

Tractor PTO, belt-pulley, properties of hydraulic fluids hydraulic couplings, Torque converters, Hydraulic circuits, position and draft control, Tractor steering mechanism-Types, caster camber, king pin inclination, toe-in and toe-out, Tractor Hitching.

Traction Theory

Traction model, Lvs placing, ply rating, tyre size, load air pressure relationship. Traction aids and their selection, mechanics of tractor chassis, Location of C.G., forces acting on tractor body, tractor stability, static equilibrium force analysis weight transfer.

Ergonomics

Ergonomic Principle application in man and machine. Human factors in design with reference to comfort, convenience and safety, exposure to noise, vibration and heat, design of operator's seat and tractor controls.

Tractor Test and Operation

Tractor testing and reliability and tractor cost analysis.

Suggested List of Practicals

- Familiarization with different types of tractors, their systems and basic engine parts.
- To study working of two stroke and four stroke cycle SI and CI engines.
- To study valve system of an internal combustion engine and drawing valve timing diagram.
- To study different cooling systems of tractor engine.
- To study an engine lubrication systems.
- To study air cleaners and fuel supply system of SI and CI engines.
- To study electrical systems of an agricultural tractor.
- To study different types of clutches.
- To study different types of gear transmission system.
- To study differential and final drive of a tractor.
- To study different brake systems used in agricultural tractors.
- To study steering mechanism of a tractor.
- To study hydraulic system of a tractor.
- To study the tyres, rims and ballasting methods of a tractor.
- Field performance evaluation of tractor drawbar.

Suggested List of Text Books

- Barger, E.L; Liljedehl, J.B. Carleton, W.M. and Me Kibben, E.G. "Tractors and their Power Units".
- Michael, A.M. and Ojha, T.P. "Principles of Agril.Engg", Vol.1.
- Nakra, C.P. "Farm Machines and Equipments".
- Gurevich, A. and Sorokin, E., "Tractors" (Russian Publication) 631,372 G 979 T.
- Hunt, "Farm Power and Machinery Management". 631,37 H 91.
- Johnson, E.J. and Hollenberg, A.H. "Servicing and Maintenance of Farm Tractors". 631m 372m J67: 1.
- Mosses and Frost, "Farm Power", 631. 37 M 85.

DAIRY AND FOOD PROCESSING OPERATIONS

Introduction

Importance of food processing and preservation, major characteristics of food raw materials and their interaction with processing.

Homogenization

Importance of homogenization and its principles, theories of homogenization, high pressure homogenization of milk and other food suspensions, design criteria for homogenizing equipment.

Thermal processing

Pasteurization : product - time- temperature relationships, pasteurization techniques and equipment including UHT processing

Sterilization: Thermal sterilization of solid and liquid foods, kinetics of microbial destruction including concept of lethality and loss of nutrient in Newtonian and non-Newtonian liquid foods, batch and continuous sterilization equipment.

Concentration through evaporation

Basic principles, in concentration of liquid foods, single and multiple effect evaporation systems including heat mass balance and performance characteristics; Steam economy by vapour recompression, selection of evaporation systems.

Drying and Dehydration

Principles of dehydration, various drying systems- tray belt, drum, spray, freeze, foam mat. osmotic and microwave, performance characteristics of various drying systems and their selection.

Separation Operations

Techniques of separation of food components; Mechanical filtration - filter medium and filter cake resistance, filter aids; reverse osmosis and ultra filtration: distillation and aroma recovery; centrifugation for cream separation; phase inversion - butter churning; leaching and solvent extraction of oil.

Suggested List of Practicals

- Measurement of fat globule size in milk and determination of homogenization efficiency.
- Determination of water activity and construction of moisture sorption isotherm.
- Estimation and measurement of cut-off size of fat globule in cream separation.
- Estimation of thermal processing time and degree of sterilization in canned food using a batch sterilizer.
- Determination of overall heat transfer coefficient for an evaporator used for concentration of milk.
- Determination of drying characteristics and diffusivity of moisture for a potato slice using a hot air drying method.
- Determination of drying of fluid entrainment and rate of drying in a drum dryer.
- Analysis of performance of a spray dryer in terms of outlet temperature and its effect on final quality of the dried product.
- Measurement and estimation of some textural parameters of a solid food.
- Estimation and measurement of time of food freezing in a plate freezer.
- Determination of vapour pressure of components of binary mixture and construction of a vapour-liquid equilibration curve.
- Determination of specific cake resistance and filter medium resistance in a filtration unit.
- Estimation of permeability of water vapour through a packaging material.
- Determination of rheological properties of Newtonian and non-Newtonian fluids.

Suggested Text Books and References

- Ahmed, Tufail "Dairy Plant Engineering and Management", Kitab Mahal, Allahabad, 1997.
- Teledo, R.M. "Fundamentals of Food Process Engineering", 2nd Ed. Van Nostrand Reinhold, New York, 1991.
- Heldman, D.R. and Singh, R.P "Food Process Engineering", A VI Pub. Co., Westport, Connecticut.
- McCabe, W.L., J.C. Smith, and P. Harriot, "Unit Operations in Chemical Engineering", 5th International Edition, McGraw Hill Inc., Singapore, 1993
- Kessler, H.G. "Food Engineering and Dairy Technology", V.A. Kessler, Frcising. Germany, 1981.

DRAINAGE ENGINEERING

Introduction

History of drainage in India and other countries,

Waterlogging

It's definition by different agencies, Sources of water logging, causes nature and its extent.

Surface Drainage

Definition and advantages of surface drainage, surface drainage system, drainage coefficient, hydrological design for different crops and catchment areas, design of open drains,

Subsurface Drainage

Advantages of subsurface drainage, subsurface drainage systems, design criteria of subsurface drainage system, determination of depth and spacing of tile drainage system, steady state approach, Hooghoudt equation, Ernst equation, unsteady approach, Glover-Dumm equation, dynamic balancing, determination of tile diameter, mole drainage.

Hydraulic design of laterals and collectors, design of gravel envelopes and filter, Design of pumped drainage and problems of disposal of drainage effluent

Layout and construction of subsurface drainage, construction equipments and costs of installation, maintenance of subsurface drainage system.

Salt Problems in Agricultural Lands

Origin of salts in irrigated soils, salinity and alkalinity in soils, sodium adsorption ratio, cation exchange capacity, classification and reclamation of saline, alkaline soil, determination of requirement of soil amendments for reclamation of salt affected soils, leaching requirement and water balance.

Suggested List of Practicals

- Laboratory study of water table profile and discharge studies in sand tank model.
- Determination of in-situ hydraulic conductivity by auger hole methods.
- Design of surface drainage for typical area with available data.
- Design of subsurface drainage by steady state method from available data.

- Design of subsurface drainage by unsteady state method from available data.
- Design of sizes of laterals and collectors from available data.
- Design of gravel envelope
- Determination of leaching curve

Suggested Text Books and References

- Schwab, G.O., Frevert, R.K., Edminister, T.W. and Barnes, K.K. "Soil and Water Conservation Engineering". John Wiley and Sons Inc. New York.
- Luthin, J.N. "Drainage Engineering", New York, John Wiley and Sons, 1966.

FOOD PRODUCTS AND PROCESS TECHNOLOGY

Food-Process Principles

Basic principles of food preservation and processing; preservation of food by removal of heat, addition of heat, removal of moisture; irradiation, addition of chemicals and fermentation:

CA/MA storage; water activity and food stability.

Emerging technologies in food processing.

Food Products Technology

Technological process outlines for industrial manufacture of selected foods of commercial importance from plant and animal sources; jam, jelly, marmalade, pickles, carbonated beverage, Fruit juice based beverages; hydrogenated vegetable oil, tea, coffee, cocoa, margarine. bakery and confectionery products, mayonnaise-textured plant proteins. breakfast cereals, butter, ice-cream, condensed milk, cheese, milk powder, malted foods and low-fat spread.

Food packaging, quality control in food industry.

Suggested Text Books & References

- Karel; M. Fennema Owen R. and Lund, D.B "Principles of Food Sciences-Part II, Physical Principles of Food Preservation", Marcel Dekker, Inc., 1975
- Desrosier N.W. and Desrosier, "The Technology of Food Preservation", 4th Ed., AVI Publishing Co., 1977
- Desrosier, N.W. 'Elements of Food Technology', AVI Publishing Co., 1977
- Gould, G.W. "Mechanism of Action of Food Preservation Procedures", Elsevier Applied Science, 1989

- Matz, S.A. "Cereal Technology", AVI Publishing Co., 1970
- Kenn.N.L "Technology of Cereals", Oxford Pergamon; 1975
- Eickles M.C. and Combs, W.B. "Milk and Milk Products", Tata McGraw Hill, 1993
- Lal, Giridhari "Preservation of Fruits and Vegetables", ICAR, New Delhi, 1986
- De, Sukumar "Outlines of Dairy Technology", Oxford University. Press, 1993

INSTRUMENTATION AND CONTROL ENGINEERING IN AGRICULTURE

Introduction

Basic concepts of measurement system configuration. Concept of accuracy precision error, resolution repeatability bias, calibration, range.

Performance characteristics of Instruments .,

Zero, first and second order instrument systems and their response to different input signals (step, ramp etc) Specification and testing of dynamic response.

Instrument for various uses

Different types of measuring instruments, their working principles, construction features, measurement of level, flow, temperature, pressure, vacuum, force, torque, power, displacement, vibration, acceleration, pH, colour, viscosity, surface tension and composition. Indicating and recording type instruments, digital displays, transmitting and telemetering devices.

Introduction to control system

Control system characteristics, purpose disturbances and stability Feed back and feed forward control strategies.

Modelling the Dynamic and Static Behaviour of Process

Mathematical modelling for physical process control, state variables and state equations, modelling difficulties and considerations. Input-output models block diagram, degree of freedom, process controllers action, P, PI, PID controllers, final control system.

Analysis of Dynamic Behaviour

Linearization of systems, Deviation variables, Application of Laplace transform in mathematical modelling of process control. Transfer function; Transfer function matrix. for processes having multiple outputs, Poles and zeros of transfer function, Qualitative analysis of response of system.

Design of Feed Back System

Block diagram, stability analysis, frequency response root locus analysis, Routh's criteria, Nyquist plots and Bode diagrams.

Control Systems for Various Uses

Electronic pneumatic, hydraulic control system and their application in Farm machinery, food processing industry aquaculture, milk processing

Suggested List of Practicals

- Calibration of Bourdon pressure gauge
- Dynamic calibration of different types of thermometers
- Determination of time constants of thermometers and thermocouples
- Calibration of differential pressure transmitters
- Calibration of velometer and hot wire anemometer'
- Speed measurement using non-contact type sensors
- Determination of discharge coefficient using orificemeter and venturimeter
- Use and calibration of rotameter, pH meter, conductivity meter and viscometer
- Static calibration of flapper nozzle assembly
- Calibration of pneumatic P, PI and PID controllers
- Study and calibration of control valves
- Cascade controls of level and flow/temperature and flow.

Suggested Text Books and References

- Doebelin, D.O. "Measurement Systems; Application and Design". McGraw Hill, 1984.
- Considine T..M. "Process/Industrial Instruments and Controls- Handbook", McGraw Hill 1993
- Fribance, A.E. "Industrial Instrumentation Fundamentals", McGraw Hill, 1962
- Coughanowr, D.R. "Process Systems Analysis and Control", McGraw Hill, 1991.
- Patranabis. D. "Principles of Industrial Instrumentation", Tata McGraw Hill, 1995
- Patranabis, D. "Principles of Process Control", Tata McGraw Hill, 1995
- Liptak, V.G. "Instrumentation in the Processing Industry", Chilton Book Company, 1973.
- Ogate, X. "Modern Control Engineering", Prentice Hall of India Ltd., 1996
- Beckwith and Buck, "Mechanical Measurements", Addition-Wesley, 1973.

List of Professional Elective Courses

Some of the Suggested Professional Electives are Motioned below.

1. Renewable Energy

2. Human Factors Engineering
3. Blowers and Compressors
4. Farm Machinery Design
5. Tillage and Traction Engineering
6. Heat and Mass Transfer
7. Remote Sensing and Geographic Information System
8. Environmental Engineering
9. Aquacultural Engineering
10. Command Area Development
11. Irrigation and Drainage Equipment Design
12. Ecology and Environmental Pollution
13. Medicinal and Aromatic Plants- Production and Processing
14. Watershed Management
15. Process Equipment Design
16. Seed Technology and Processing
17. Horticultural and Plantation Product Processing
18. Bioprocess Engineering
19. Concentration and Dehydration of Foods
20. Fats and Oils Processing
21. Fish Preservation and Processing Technology
22. Convenience Foods and Beverages
23. Physical Properties of Food and Biomaterials
24. Food Plant Utilities and Sanitation
25. Animal Science
26. Database Management and Microprocessor Applications
27. Marketing Management
28. Engineering Economy and Project Planning
29. Utilization of Electrical Energy in Agriculture
30. Operations Management
31. Food Science

RENEWABLE ENERGY

Introduction

Solar Resources Solar energy and biosphere, solar position Insolation; 'solar energy option, solar radiation, incident angle.

Solar Thermal Collectors

Flat plate and non-concentrating collectors, liquid cooled flat plate collectors, air cooled flat plate collectors, concentrating collectors, performance of solar collectors.

Thermal Solar Energy Applications

Solar energy operated systems for heating, cooling, drying and water pumping, solar pond.

Thermal Energy Storage

Principles of photovoltaic conversion, photo voltaic effect and devices, photo voltaic materials

Energy From the Wind

Wind power availability, wind regime, types of wind mills and their characteristics, use of wind machines, wind pump and rotor.

Bioconversion

Biomass, conversion process, anaerobic fermentation of biomass, biogas composition, biogas plants

Biogas Application

Design of biogas system for heating, lighting, cooking and running I.C. engines.

Alternate Fuels

Alcohol fuels, use of alcohol fuels in I.C. engines, producer gas system, use of CNG in I.C. engines, Geothermal Energy

Suggested Text Books & References

- Sukhatme, S.D. "Solar Energy" D Tata Mc Graw Hill Publication Co. Ltd. New Delhi, 1990
- Duffie, John, A. and Beckman. W.A. "Solar Engineering Thermal Processes" John Wiley & Sons, 1980
- Lysen, R.H. "Introduction to Wind Energy" CWD. Netherlands, 1981.
- Biomass Combustion Technologies FAO 1988
- "Energy Conservation and Renewable Energies for Green House Heating" Technical Series-FAO 1988
- Vogt, F. "Energy Conservation and use of Renewable Energies in the Bio-Industries" Pergamon Press, New York.

HUMAN FACTORS-ENGINEERING

Introduction

Importance of ergonomics and its application agriculture; Human biological: digestion and absorption of foodstuffs, liberation' and transfer of energy.

Physiological stress Indices and their Methods of Measurement

Concept of indirect calorimetry; physiological responses and techniques of their measurements; Energetic efficiency of muscular work

Anthropometry and Bio-Mechanics

Structural and functional body dimensions; Instrumentation and their methods of measurement; Analysis and application of anthropometric data.

Visibility/Readability of Dials

Visual displays; Process of Seeing; Horizontal and Vertical fields of vision; colour discrimination; Quantitative and qualitative visual displays, signals and warning lights.

Design of controls and Work Space Envelope

Functions of controls; Identification. of controls; Design aspects of hand and foot controls mainly. Steering, clutch, accelerator, brake and pedal design on tractors; Arrangements of controls, work-space envelopes; Analysis and design of Job requirements.

Energy Cost of Various Activities.

Work physiology in agriculture; Scaling of physiological work. Fatigue allowance and indices, shift work, work-rest scheduling.

Physiological Factors Affecting Operator – Machine Performance

Limitations of human in relation to stresses and demands of working environments; environments; Thermal: Heat exchange process and coefficients, physiological mechanics of heat regulation, management of temperature problems, work load and allowance in hot environment. Mechanical: Noise and loss of hearing, physiological effects acceptable ;limits, handling of noise problems, ear protection devices, Vibration sources of vibration, effects on physiological responses control of vibration on agricultural equipment. Illumination: Nature and measurement of light, colour systems, amount of illumination, roadway features influencing visibility, vehicle lights.

Postural comfort and Operator Safety

Problems-of posture and comfort; science of seating cushion functional requirements,

static and dynamic compatibility of operator-seat-machine; Engineering principles applied to industrial and agricultural safety. Road accidents, road signs and accident prevention; Safety symbols and signs, hand signals, colour codes for agricultural equipment.

Suggested Text Books and References

- Sanders, M.S. and McComack. E.J. "Human Factors in Engineering and Design". Tata McGraw Hill, New York, 1992.
- Obome. David, J. "Engineering at Work". John Wiley and Sons Ltd., 1982.
- Astand, P.P. and Rodaid K. "Text Book of Work Physiology". McGraw Hill Book Company, New York, 1970.
- Grandjean, E. "Fitting the Tack of the Man". Taylor and France Ltd., U.K. 1981.

BLOWERS AND COMPRESSORS

Introduction

Applications of blowers and compressors in different fields of agricultural engineering.

Definitions and Terminology

Classifications of blowers; Performance; Efficiency; Affinity laws.

Basic Theory of Blowers

Specific speed; Velocity diagrams; Ideal head equations; Theoretical characteristics curves; Circulatory flow and prerotation of fluid; Incompleteness of the ideal head equations; The actual head capacity curve; Brake horse power and efficiency curves.

Vortex Theory of Euler's Head for Incompressible Fluid

Radial impeller

Axial flow impeller

Forced vortex axial flow impeller

Design of Radial Type Blowers

Effect of compressibility on design; Pipe connections and velocities; Impeller inlet dimensions and vane angle; Flow conditions in the impeller; Impeller outlet dimensions and vane angle; Leakage losses; Design of vanes; Design of the volute; Design of the diffuser; Multistaging.

Design of Axial Flow Blowers

Terminology and geometry of the axial flow impeller vanes; Experimental design factors; Axial flow (single stage) design procedure; Air foil theory; Blower casing.

Suggested Text Books and References

- Stepanoff, A.J. "Turbo Blowers Theory Design and Applications of Centrifugal and Axial Flow Compressors and Fans". John Wiley and Sons, 1955.
- Church, A.H. "Centrifugal Pumps and Blowers". John Wiley and Sons, New York, 1993.
- Osborne, W.C. "Fans". Pergamon Press, New York. 1977.

FARM MACHINERY DESIGN

Introduction

Design consideration of Agril. Machines their draft requirement, engg. materials and their properties.

Bearings

Bearing definition, classification and their application. Journal bearing, their application and design, lubrication theory of journal bearing. Loss of power due to friction and neat balance. Collar and Pivot thrust bearing, rolling bearings classification and their application. Selection of rolling bearings.

Power Transmission

Flat belt drive its classification and advantage and disadvantage. Velocity ratio and power transmitted by the drive. Length of belt. Types of belting materials. Stresses developed in the belt and design procedure of flat belt drive. Types of flat pulleys. Design of cast iron and mild steel pulleys. V -belt drive its application, advantage and disadvantage, cross section of V-belts, various formula used in the design, Design procedure of V-belt drive. Design of V-grooved pulleys. Designation of V-belts. Chain drive: introduction, application, advantages and disadvantages, types of chain. Design of roller and bush chain drive including design of sprockets.

Tillage Equipment

Tillage implements and their design considerations. Mould board plough as 3 sided spatial wedge, types and kinds of mould board. Theoretical furrow slice inversion. Design of frontal plant. Design of cylindrical, cylindrodial and semi helical type mould board plough bottom. Standard dimensions of plough share and land side. Introduction of disk implements and their design consideration, Design of disk for different tools, spacing in

multi disk implements, forces acting in vertical and inclined disk. Cultivators and their application, Design of different soil engaging tools such as shovel and sweep. Design of shank.

Planting Machinery

Design parameters of sowing and planting equipment. Design of seed metering mechanism, Design considerations of seed and fertilizer box and frame.

Testing Procedure of Agril Machinery

BIS and RNAM test codes of agricultural machines, performance requirements design of safety' devices.

• Suggested Text Books & References

- Bernacki, H., Haman, J. and Kanafojski, C Z "Agricultural Machines Theory and Construction", Vol. I & II. US Dept. of Commerce, National Technical Information Service, 1 972.
- Krutz, Gary, Thompson Lester and Claar, Paul. "Design of Agricultural Machinery", John Wiley and Sons, 1984.
- Roy Bainer , Kepner R.A. and Berger, E.L. "Principles of Farm Machinery", John Wiley and Sons, 1963.
- Pandey, H.C. and Shan,.C.S. "Elements of machine Design".
- Sharma and Agarwal. "Machine Design".
- Singh, Sadhu. "Machine Design".
- "Design Data Book Compiled", Faculty of Engg. P.S.G, College of Technology, Coimbatore.

TILLAGE AND TRACTION ENGINEEING:

Tillage

Introduction

Soil physical conditions requited for optimum plant growth, role of cultivations in providing these conditions, critical review of Current crop husbandry practices.

Shear and Compressive Strength of Soil

Soil failure criteria, boundary stress and stress conditions, retaining wall theory and its application in the design of soil engaging components, general and compressive soil failures.

Assessment of Dynamic Properties of Soil

Determination of cohesion, adhesion, friction strength in compression and shear clod and bulk shear strength. Influence of soil moisture content on above properties and soil consultancy, Atterberg limits.

Mechanics of Passive Tillage Tools

Wide tine failures with straight blades; vertical narrow tines and inclined rigid tools soil failure patterns, force prediction, effect of rake angle on penetration and draught, shallow and deep tines concepts.

Mechanics of Powered Tillage Tool

Rotary and Vibratory tillage tools and their design parameters; depth, bite length, ratio of peripheral and forward speed, kinematics of rotary power blade etc: Mechanics of soil cutting and force prediction models.

Design Considerations of Tillage Tool

Design and selection of equipment for basic cultivation operations; soil loosening, compaction, puddling for rice, particles and aggregate arrangement, mixing, inversion, soil movement and smoothing, bed and ridge formation, weed cutting etc.

Performance of Tillage Tools

Factors influencing draught; Scouring and power requirement, soil/soil and soil/metal sliding resistance, implement shape and speed. Methods of reducing draught.

Traction

Mechanics of traction and transport devices, performance characteristics of off-road vehicles; drawbar pull, drawbar power, coefficient of traction, wheel slip tractive efficiency, motion resistance, fuel economy indices, weight transfer traction tyres and tracks, effects of tyre design parameters on traction, selection of pneumatic tyres for different operations, Methods of improving traction; traction aids and their selection for different soil conditions. And field operations. Prediction and evaluation of the traction and transport devices. ASAE tractor drawbar performance predictor; concept and its application. Modeling of traction performance.

Suggested Text Books and References

- Gill, W.R. and Vanden Berg G.E.. "Soil Dynamics in Tillage and Tractors" ARS, USDA, 1968.
- Wong, J. Y. "Theory of Ground Vehicles" John Wiley and Sons Inc. New York, 1993.
- E. McKeys, "Soil Cutting and Tillage" Elsevier, Tokyo, 1993.

HEAT AND MASS TRANSFER

Heat Transfer

Review

Introductory concepts on conduction, convection and radiation

Conduction

Fourier's law thermal conductivity dependence on temperature and pressure in fluids. Heat conduction through composite walls, optimum thickness of insulation, general conduction equation under unsteady state. Transient numerical method for unsteady state conduction in simple geometrical shape e.g. slab, cylinder and sphere.

Free and forced convection; Newton's law of cooling. Film coefficient, correlation of Nusselt number. Prandtl number and Reynolds number. Empirical and practical relations for forced convection, condensation and boiling. Relation of Nusselt number and Grashof number in natural convection systems including other empirical relations. Combined free and forced convection.

Radiation

Stefan-Boltzmann law, emissivity, mechanism of radiation heat transfer in systems including solar radiation collectors. Heat transfer analysis involving conduction, convection and radiation by network.

Heat exchangers

Overall heat transfer coefficient, fouling factors, log mean temperature difference. Heat exchange mechanism in various types of heat exchanger e.g. tubular, extended surface and plate heat exchangers, effectiveness - NTU relationship.

Mass Transfer

Steady-state molecular diffusion in fluids at rest and in laminar flow - Fick's law, mass transfer coefficients. Mass-heat-momentum transfer analogies. Unsteady-state diffusion. Diffusion in solids. Interphase mass transfer.

Laboratory

Determination of thermal conductivity of a powder and insulating material under steady - state using two slab guarded hot plate method.

Determination of thermal conductivity and thermal diffusivity of a food.

Determination of specific heat using differential scanning calorimetry (DSC)

Measurement of heat transfer coefficient of air under free and forced convection using heat and mass transfer analogy

Determination of overall heat transfer coefficient in an agitated vessel

Determination of heat transfer coefficient of a boiling liquid

Determination of effect of packing on heat transfer in packed beds

Determination of overall heat transfer coefficient in parallel-flow and counter-flow heat exchangers

Measurement of emissivity of a surface

Study of a plate heat exchanger

Study of heat transfer from pin/fin

Study on boiling heat transfer and measurement of critical heat flux

Study of heat transfer in a fluidized bed

Determination of mass diffusivity by Winkelmann method

Generation of equilibrium data for mass transfer operations

Instruments/Equipment for the laboratory work

Fluid bed dryer, Two slab guarded hot plate apparatus, Line heat source apparatus, Differential scanning calorimeter, steam-jacketed agitated vessel, tubular parallel-and counter-flow heat exchangers, Plate heat exchanger, pin/fin heat exchanger, single effect evaporator, multiple effect evaporator

Suggested Text Books & References

- Geankoplis, C.J. "Transport Processes and Unit Operations", Allyn and Bacon Inc., 1978.
- Ozisik, M.N. "Heat Transfer A Basic Approach", McGraw Hill Book Co., 1977.
- Bird, R.B Stewart, W.E. and Lightfoot, E.N. "Transport Phenomena", John Wiley and Sons Inc., 1960.
- Holman, J.P. "Heat Transfer", McGraw Hill Book Co., 1963.
- Krieth Franc and Black, W.Z. "Basic Heat Transfer", Harper and Row Publisher, 1980.
- Treybal, R.E. "Mass Transfer Operations", McGraw Hill Book Co., 1968.

- Kern, D.Q. "Process Heat Transfer", McGraw Hill Book Co., N. Y., 1950.

REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

Introduction

Basic principles of remote sensing; Conventional aerial photography; Non-conventional photography; Non-photographic sensors; Rocket and earth orbital imagery; Energy sources and radiation principles; Energy interaction in the atmosphere and with earth surface; Nature of electromagnetic radiation; Active and passive remote sensing systems; Earth resource satellite .

Photographic Systems for Remote Sensing

Fundamental consideration; Aerial photographic film, cameras and filters.

Imaging and Nonimaging Sensors

Sensor fundamentals; Nonimaging sensors; Optical mechanical scanners; Radiometric calibration.

Remote Sensing Data Systems Processing and Management

Information system; Image data storage and retrieval; Image data input and output; Image processing principles; Image processing implementation; Pattern recognition.

Ground Investigations in Support of Remote Sensing

Test sites; Common measurements; Geologic investigations; Agriculture and Forestry investigations; Atmospheric investigation.

Image Interpretation

Activities of image interpretation; Elements of image interpretation; Techniques of Image interpretation; Visual requirements for image interpretation; Image interpretation equipment.

Digital Image Processing and Geographic Information System

Image rectification and restoration; Image enhancement; Contrast manipulation; Multi image manipulation; Image classification; Post classification smoothing; Classification accuracy assessment; Basic concepts of GIS; Data imagery and GIS application for land and water resources.

Suggested Text Books and References

- Barret, E.C. and Curits, L.F. "Introduction to Environmental Remote Sensing". John Wiley and Sons Inc. New York, 1976.
- Chern, H.S. "Space Remote Sensing System an Introduction". Academic Press Inc. New York, 1985.
- Lillesand, T.M. and Kiefer, R.W. "Remote Sensing and Image Interpretation". John Wiley and Sons Inc., New York, 1994.
- Hard, R.M. "Remote Sensing: Methods and Applications". John Wiley and Sons Inc., New York, 1986.
- Reeves, R.G., Ansom, A. and David Landen. "Manual of Remote Sensing". Vol. I and II.
- American Society of Photogrammetry. Falls Church Virginia, 1975.
- Lintz, Joseph (Jr.) and Simonett, D.S. "Remote Sensing of Environment". Addison Wesley.

ENVIRONMENTAL ENGINEERING

Storage Structures for Perishable Products

Food behavior and spoilage in storage, conditions for storage of perishable products; economic, aspects of fruits and vegetable storage, functional requirements of storage, control of temperature and relative humidity inside storage, calculation of refrigeration load, modified atmospheric storage and control of its environment, air movement inside MAS storage sanitation

Storage of Grains

Destructive agents respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside grain storage through natural ventilation, mechanical ventilation, artificial drying; grain storage structure such as bukhari, morai, kothar, silo design; control of environment inside silo

Poultry Housing

Functional requirements production practices; environmental conditions favourable for poultry rearing, poultry control of environmental temperature relative humidity, air purity, light air movement inside poultry; heat and moisture production inside poultry, improving sanitation for poultry; space requirements, arrangement of space for various equipment, insulation and ventilation conditions, ventilation system, ventilation for heat and moisture removal

Dairy Buildings

Physiologic reactions of animals to ambient temperature and relative, humidity, functional

requirement, production practices; environment favourable to livestock, control of atmospheric temperature humidity, light, air movement ordinance; space requirement, arrangement of space for various, related equipment, insulation, air flow for heat and moisture removal.

Green House Technology

Basic approach and scope in India, attributes of green' house 'technology;' types' o-f green house, green house environment control, construction equipment and material.

Land and Water Use

Ecological approaches to land use, soil degradation, causes, effects and remedies Reclamation of wasteland, environmental aspects of irrigation; water logging, salinity and alkalinity development, remedies, water' pollution laws and standards. Water analysis and treatment. Safe ground water use; sea water intrusion and control, arsenic problem in ground water and control measures. Remote sensing for environmental planning surveys. Environmental aspects of aquaculture; effects of aquaculture on environment, analysis wastewater from aquaculture farms, dissolved oxygen level, ammonia, pH heavy metals, treatment of waste water.

Suggested Books & References.

- Rao C.S. "Environmental' pollution' Control Engineering", Wiley Eastern Ltd, New Delhi, 1987.
- McGauhey, P.H. "Engineering Management of Water Quality", McGraw Hill, New York, 1987.
- Eckenfelder W.W. and D.J.O'connor, "Biological Waste Treatment", Pergamon Press, New York, 1961.
- Dix, H.M. "Environmental Pollution"; John Wiley: and 'Sons, New York;' 1981,
- Bames, O, Biss, P.J. Gould' B.W: and Vallentine, H;R. "Water and .Waste Water Engineering Systems", Pitman Books Ltd, London;' 1981.
- Pillay, T.V.R "Aquaculture and: Environment Fishing News Books", Blackwell Science' Ltd, Oxford, 1995.

AQUACULTURAL ENGINEERING

Introduction

Scope of aquaculture engineering and its application in fish farming.

Type of Fish culture' Practices and Requirements of cultural Species

Planning of Fish Farm

Survey and site selection; Study of hydrometeorological and environmental problems; Study of engineering aspects of water availability and sources; Surface and ground water quality; Types of soils and salts present in soil; Vegetation; Socio-economic aspects;

Design of Fish Farms

Component of fish farm; Design of nursery; Transition and rearing ponds; Types of earthen ponds and their design; Design of dykes; Earth work estimation; Pond capacity estimation; Project layout.

Water Management System

Design of drainage system for aquacultural farm; Design of fish race ways, ladders and fish lifts; Spillways; Design of sluices; Design of channels; Gates and canals for tied fed and pump fed farms.

Aquacultural Equipments

Different types of pumps; Functional design of biological and mechanical filters; Types of design of aeration equipments; Feeders; Blowers.

Suggested List of Experiments

- Study of different types of ponds.
- 2, Study of different design criteria of fish pond and their design and layout.
- Study of water supply and drainage flow channel for different-kinds of fish ponds.
- Study-and 'lay-out of fish-race ways,
- Study of water measuring devices for fish ponds,
- Study of biological and mechanical filters.
- Study and design of spillways.
- Study of aeration equipments for aquaculture.

Suggested Text Books and References

- Wheaton, F.W. "Aquacultural Engineering". John Wiley, 1997.
- Bose, AN., Ghosh, S.N. Yang C.T. and Mitra, A. "Coastal Aquacultural Engineering". Cambridge University Press, 1991.
- Schwab, G.O. "Soil and Water Conservation Engineering". John Wiley, New York, 1959.
- Hunt, M. "Text Book of Fish Culture - Breeding and Cultivation of Fish". Fishing News Book Ltd., 1979.

COMMAND AREA DEVELOPMENT

Introduction

History of command area development in India; Different commands presently existing in India; Legal provisions of command area development authority and various facilities' existing' for development; Consolidation of holding and CADA.

Irrigation Development

Canal classification: Gross and cultural command areas intensity of irrigation; Planning of irrigation canal system; Preliminary survey and detailed survey of CADA; Duty of water; Canal losses: Estimation of design discharge of canal; Type of canal outlets; Delivery of water to farms.

Land Grading and Field Layout

Criteria: Survey and design; Design methods; Plane methods; Profile methods; Plan inspection method and contour adjustment methods; Earth work quantities; Design of levelling in existing fanner's fields.

Land Levelling Equipments and Their Use

Bulldozers; Tractor drawn scrapers; Road graders; Animal drawn buck scrapers; Land plane; Wooden float; Equipment for making ridges and ditches; Bund former; Wooden A-frame: Ridger; Bullock drawn lister; Tractor cultivators and drag line excavators; Fundamentals of earth moving, rolling assistance, effect of grade on required tractive effort; Coefficient of traction: Draw bar pull; Rim pull.

Channel Lining

Types of canal lining for medium and low discharges including field channels; Design of lined canal and economics of canal lining; Improvement of existing system; Materials of lining: Brick lining; Concrete lining; Plastic lining; Lining with other materials; Method of layout and construction of lining field channels.

Water logging and Drainage

Nature and extent of waterlogging; definition of waterlogging; Provision of drainage in CADA as well as other streams.

Problematic Soils

Definition of terms; Saline and alkali soils; Origin and causes of salinity in irrigation soils; Leaching requirements and methods; Reclamation and management of salt affected soils.

Ground Water Sources

Ground water regions of India; Assessment of ground water resources; Consumptive use of surface and ground water; Economics of water resources.

Suggested Text Books and References

- Murthy, C.S. "Design of Minor Irrigation and Canal Structures". Wiley Eastern Ltd., 1994.
- Punmia, B.C. and Pande, B.B.L. "Irrigation Water Power Engineering, 1987".
- Hoffman, G.J., Howell, T.A. and Solomon, K.N. "Management of Farm Irrigation System", ASAE, 1990.
- Murty, V.V.N. "Land and Water Management Engineering". Kalyani Brothers, 1985.
- Various literature brought out by "Command Area Development Authority", Ministry of Water Resources, Govt: of India.

IRRIGATION AND DRAINAGE EQUIPMENTS DESIGN

Introduction

Various equipments used in irrigation and drainage; Centrifugal pumps; Horizontal pumps; Deep well pumps; Propeller pumps; Air lift pumps; Sprinkler systems; Multi stage pumps; Micro irrigation systems.

Design of Centrifugal Pumps.

Classification of centrifugal pumps; Theory of centrifugal pumps; Fundamental equations of centrifugal pumps; Efficiencies of centrifugal pumps; Ideal; virtual and manometric heads of centrifugal pumps; priming of centrifugal pumps; Cavitation in centrifugal pumps; Net positive suction head; Multistage centrifugal pumps; Design of impellers and casing of centrifugal pumps; Selection of centrifugal pumps.

Sprinkler Irrigation

Types of sprinkler systems; Uniformity and efficiency of sprinkler irrigation; Sprinkler selection and spacing; Design of main and lateral lines of sprinkler irrigation system. Pump and power unit selection; Operation and maintenance of sprinkler systems.

Microirrigation System

Components of the system; Emission devices; Simple Emitters, Micro-sprinklers, Line sources, Bubblers, micro-tubes and other devices; Filters, screen, media and hydro-cyclone; Vntury injection system; Basic hydraulics; Emitter flow variation and uniformity coefficients of emitter flow; Design of laterals, sub-main. And main-lines of micro-

irrigation systems; Maintenance, filtration and flushing.

Suggested Text Books and References

- Michael, AM. "Irrigation Theory and Practice"; Vikas Publishing House, New Delhi. 1978
- Stepanoff, A.J. "Centrifugal and Axial Flow Pumps, Design and Applications". John Wiley and Sons,. New York, 1948.
- Kavassik, I.J "Engineers Guide to Centrifugal pumps:". McGraw Hill Book Company, 1964.
- James, L.J. "Farm Irrigation System Design". John Wiley, 1988.
- Luthin, J. "Drainage Engineering". Wiley Eastem, 1970

ECOLOGY AND ENVIRONMENTAL POLLUTION

Introduction

Role of ecology in environment; Ecosystems and system ecology; Various type of pollution and their role in environmental degradation.

Ecology and Environment

Ecological terminologies and principles; Ecological developments; Ecological pyramids and ecological factors

Concept of Eco System

Structural and functional attributes of eco system; Productivity in eco-system; Energy flow in. eco System; Bio Geochemical cycles of C.O.N. P and ecological energetic and energy budgeting in eco systems.

Biosphere and Community Organization

Ecological succession; Eco system development; Seral and climax concepts in succession; Major ecosystem of the globe.

Concept of System Ecology

Modelling of ecosystems and their regulation; Science of cybernetics; Aging of ecosystem and concept of sustainable ecosystem

Causes and Sources of Air Pollution

Point and nonpoint sources of air pollutant viz oxides N, S, CO₂ CH₄: and hydrocarbons;

PAN and photochemical smog formation; Effects on Various living and non living components of environment and their control measures in industrial sector.

Causes and Sources of Water pollution

Causes and sources of water pollutants in water and waste water viz. BOD, COD, DO, TDS, DS, SS, heavy metals, oil and grease; Agrochemical residues and problems of Eutrophication.

Thermal and Noise Pollution

Problems, health, hazards and control measures; Radioactive pollution and mechanisms of biological actions of main types of nuclear pollutants.

Soil pollutants

Sources; Mechanisms of formation and impact of major types of soil pollutants such as heavy metals, pesticides, insecticides and other recalcitrant xenobiotics.

Global Environmental Problems

Pollution problems of global dimensions viz. O₃ depletion, global warming, acid rains their causes, consequences and remedial measures.

Equipments and Methodologies

Basic concepts of equipments and methodologies for measurement and control of main types of environmental pollutants.

Legal Aspects of Pollution

Legal aspects of environmental pollution; Indian laws and policies for control of environmental pollution, vis-a-vis international scenario.

Suggested List of Experiments

- Analysis of grassland, eco system to calculate IVI.
- Analysis of forest ecosystem for profile diagram preparation.
- Analysis of floristic and faunal composition of an aquatic ecosystem.
- Measurement of primary productivity of an aquatic ecosystem:
- Analysis of rural and industrial ecosystem for energy budgeting.
- Monitoring of physical factors Le. wind, light, temperature, altitude, humidity, pressure, etc. in various habitats.
- Monitoring of SPM of ambient air through high volume air sampler.

- Measurement of SO₂ in ambient air using high volume air sampler.
- Measurement of DO and BOD in waste water.
- Measurement of COD of polluted water samples.

Suggest Text Books and References

- De, A.K. "Environmental Chemistry". Wiley Eastern Ltd., 1989.
- Rao, C.S. "Environmental Pollution Control Engineering". Wiley Eastern Ltd., 1992.
- Odum, P.P. "Fundamentals of Ecology" Philadelphia Saunders, Philadelphia, 1978.
- Chapman, J.L. and Reiss, MJ. "Ecology Principles and Application". Cambridge University Press, 1997.

MEDICINAL AND AROMATIC PLANTS PRODUCTION AND PROCESSING

Introduction

History; Classification; Economically important spices and medicinal and aromatic plants of India; Ecological distribution of major medicinal and aromatic plants and spices in different agro-climatic regions of India; National and International trade.

Cultivation

Climate and soil; Varieties; Methods of cultivation; Planting and after care; Major diseases and pests; Harvesting- case studies.

Post-Harvest Handling and Storage

Sorting; Grading and cleaning; Packaging; Storage requirements; Control of post harvest diseases and pests case studies.

Processing and End Uses of Products

Processing methods for conventional products; Production of extracts and purification; Value added products from spices, medicinal and aromatic plants - case studies.

Quality Control

Active compounds of medicinal and aromatic plants and spices; Possible adulterants; National and International standards and regulatory agencies for their implementation.

Suggested Text Books and References

- Rastogi, P. et al, "Compendium of Indian Medicinal Plants". CSIR Publication 1991.
- Jain, S.K. "Medicinal Plants". National Book Trust, 1968:
- Kumar, N. et al. "Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants". Oxford and IBH Publishing Company, 1997.
- Bajaj, Y.P.S. "Medicinal and Aromatic Plants". Springer -Verlag, 1988.
- Pruthi, J.S. "Quality Assurance in Spice and Spice Products". Allied Publishers Pvt. Ltd., 1998.
- Purselove, J.W. et al. "Spices". Vol. I and II. Longman Group Incorporated, 1981.

WATERSHED MANAGEMENT

Introduction

Watershed management concepts leading to control of quality and quantity of runoff; Geomorphology of watersheds.

Land Management

Management of undulating lands; Soil erosion and conservation measures through both engineering and vegetative methods; Soil salinity, alkalinity control measures; Special management techniques for arid, semi-arid and forest watersheds.

Water Management

Water harvesting in-situ and reservoirs; Preparation of water harvesting catchments; Common water harvesting techniques; Seepage control in reservoirs; Construction of reservoirs/ponds and bunds; Control of evaporation from reservoirs.

Project Planning Methods

Preparation of project plans; Preparation of reports; Cost benefit analysis; Methodologies to encourage people's participation.

Suggested List of Tutorials

- Contour survey map preparation and identification of topographic features.
- Development of morphological relationships for different types of watersheds.
- Exercises on photo interpretation methods.
- Design of water harvesting and storage structures.
- Exercise on seepage and evaporation losses from reservoirs.
- Exercises on salinity, alkalinity control problems.
- Project planning for an affected areas.
- Evaluation of effects of watershed management programme consideration in an area.

Suggested Text Books and References

- Dhruvanarayana, V.V., Shastri, G. and Patnaik, U.S. "Watershed Management". ICAR, 1989.
- Singh, G., Venkatraman, C., Shastri, G. and Joshi, B.P. Manual of "Soil Conservation Practices". Oxford IBH Publishing Company Pvt. Ltd., 1980.
- Suresh, R. "Soil Water Conservation Research in India", 1992.

PROCESS EQUIPMENT DESIGN

Introduction

Design consideration and their interaction with material selection, equipment size and structural design, design codes, energy balance calculations for preliminary estimation of plant capacity and equipment size.

Materials of Construction

Metallic and non-metallic materials used in construction of food processing equipments, welding and machining of stainless steel.

Storage and Pressure Vessels

Design of shell, shell covers and other components; design of vessel for drum drying storage of liquid foods and food grains, etc.'

Materials Handling

Solid conveying equipment - belt, screw, bucket and chain conveyors, pneumatic conveyors; conveying of fluids -Design of pipe and piping systems for Newtonian and non-Newtonian fluids: Sanitary pipe fitting and valves, design of CIP system.

Design of Heat Exchangers

Plate, shell and tube, scraped surface heat exchangers used in heating and cooling of liquid foods.

Grain Processing Equipment

Cleaners, graders and other sorting equipment used in grain processing.

Suggested Text Books and References

- Joshi, M.V., "Process Equipment Design", 2nd Edition, MacMillan India, Limited, Delhi, 1981
- Bhattacharjee, B.C. "Chemical Equipment Design", 1990
- Kessler, H.G. "Food Engineering and Dairy Technology", V.A. Kessler, Freising, Germany, 1981
- Geankokplis, C.J. "Transport Processes and Unit Operation" 3rd Ed. Prentice Hall India New Delhi, 1993
- Brosnel and Young, "Process Equipment Design", John Wiley Inc. 1975
- Kern, D.Q. "Process Heat Transfer". McGraw Hill 1990.
- Spivakovsky, A. and Dyachkov, V., "Conveyors and related equipment", Trans. by Don Danemanis, Peace Publishers, Moscow.

SEED TECHNOLOGY AND PROCESSING

Seed Production Technology

General Principles: Genetic principles; Agronomic principles; Harvesting of seed crops. Nucleus and Breeder's seed- method of maintenance of nucleus and Breeder's seed in self - fertilized and cross- fertilized crops; Methods of maintenance of Breeder's seed of Apomictic species and Artificial polyploids, Foundation and certified seed production: Seed production of cereals, pulse, oil seeds, fibre crops, forage crops, sugar crops and their hybrid varieties.

Seed Processing Technology

Preparing seed for processing, Seed moisture and drying, Air screen cleaner, shape and size separators, gravity separators, surface texture separators, affinity for liquid separators, colour separators, electrical conductivity separators, seed treatment, seed elevators conveyors, safe seed storage, seed packaging and handling, seed bins, dust removal, seed blending, seed marketing and distribution; Planning a new seed processing plant & management.

Seed Testing

Determination of seed density, Tolerances, heterogeneity, Purity, genuineness of variety, Germination, Viability, Vigour and health and other factors affecting them.

Seed Certification and Legislation

Objectives and concepts of seed certification; seed certification agencies, minimum seed certification standards for breeder's seed, certified seeds, field and seed inspection, methods of inspection, Post harvest inspection seed legislation laws.

Seed Industry in India and Their Role in Agricultural Development

Seed industry before independence; National seeds corporation: State seeds, Development corporation; Five year plans, Private seed industries.

Suggested Text Books & References

- Agrawal, R.L. "Seed Technology". Oxford & IBH Publication, Co. Pvt Ltd, New Delhi-1994.
- Gregg, B.R., Law, A.G. Viridi, S.S. and Balis.J.S. "Seed Processing", National seed corpn. New Delhi, 1990.
- Douglas, J.E. "Seed Certification Manual" National seeds corpn. New Delhi, 1970.
- Saxena, R.P. "Beej Sansadhan (Hindi). Directorate, Translation and Publication",

- G.B.Pant University Pantnagar, 1984.
- Douglas. J.E. "Seed Production Manual". National Seeds Corporation and Rockfeller Foundation. New Delhi, 1969.

HORTICULTURAL AND PLANTATION PRODUCT PROCESSING

Introduction

Various fruits and vegetables, their post harvest technology, packaging and different methods of processing; Composition and Physical Properties of Fruits and Vegetables; Major nutrients in fruits and vegetables; Dietary significance; Fruits and vegetables as living objects; Physicochemical changes during growth and maturation.

Post Harvest Technology

Harvesting indices; Methods of harvesting; Pre cooling; Storage of fresh fruits and vegetables; Pre treatments to prevent post harvest diseases.

Packaging

Packaging of fresh commodities; Different types of packaging materials for processed products; Packaging equipments.

Preparation for Processing

Washing; Sorting and grading; Peeling and slicing; Blanching;

Juices and Juice Concentrates

Selection of fruits/vegetables; Equipments for juice extraction; Methods of classification: Preservation using chemical preservatives; Thermal process requirements for juices; Methods of concentration; Types of evaporators; Selection of evaporators; Freeze concentration.

Freezing

Methods for freezing; Freezing equipments; Frozen storage; Thawing.

Drying

Methods of drying; Mechanisms of drying; Osmo-air drying; Foam mat drying; Changes in -food during drying; Selection of drying method; Freeze drying.

Canning and Bottling

Steps in canning; pH classification of fruits and vegetables and their process requirements; Methods for canning major fruits and vegetables; Spoilage of canned foods.

Jams, Jellies and Related Products

Definition and specification; Methods for manufacture of major products; Theory of gel formation; Defects of Jelly and their causes.

Pickles, Sauces and Chutneys

Product specifications; Basic principle underlying preservation; Methods for preparation; Defects of pickles and their causes.

Essential Oils and Oleo resins

Methods of manufacturing essential oils and oleoresins; Uses and specifications.

Plantation Products

Chemistry of tea, coffee, and cocoa; Technology for production of tea, coffee and cocoa; Methods for manufacturing major products based on tea, coffee and cocoa; Technology of coconut and rubber.

Suggested Text Books and References

- Woodroof, J.G. and Luh, B.S. "Commercial Fruit Processing". The AVI Publishing Company.
- Luh, B.S. and Woodroof, J.G. "Commercial Vegetable Processing". The AVI Publishing Company.
- Ryall, A.L. and Lipton, W.J. "Handling Transportation, Storage of Fruits and Vegetables, 1972".

BIOPROCESS ENGINEERING

Introduction

Overview of the course and recent developments in bio-processing.

Industrial Fermentations

Basic principles and operations, batch and continuous growth of microorganisms, growth pattern and growth kinetics in batch and continuous system, submerged fermentation and

solid state fermentation.

Biochemical and Biological Reaction Systems

Bioenergetics, biocatalyst, enzyme kinetics, immobilized enzyme systems.

Basic Concepts in Design and Analysis of Bioreactors

Ideal bioreactor (batch and continuous Stirred tank), feed-batch bioreactor, bubble column bioreactor, immobilized biocatalysts reactor, animal and plant cell reactor, aeration and agitation systems.

Media and Air Sterilization

Importance of sterilization, thermal death kinetics, design of sterilization equipment.

Product Recovery Operation

Recovery of cells and solid particles, filtration, centrifugation, sedimentation, emerging technologies, chromatography and fixed bed adsorption, membrane separation, reverse osmosis, ultra filtration, electrophoresis

Bioprocess Instrumentation

Off-line analytical methods, physical and chemical sensors, On-line sensors, biosensors

Suggested Text Books and References

- Kumar, H. D. "A Textbook on Biotechnology" 2nd Ed.,1998.
- Aiba, S., A.E. Humphrey and N.F.Mills., "Biochemical Engineering" 2nd Ed., 1973.
- Baily, J.E. and Ollis. D.F., "Biochemical Engineering Fundamentals", 2nd Ed., 1986.
- Shuler, M.L. and Kargi., F., "Bioprocess Engineering-Basic Concepts", 1992
- Prescott and Dunn., "Industrial Microbiology".

CONCENTRATION AND DEHYDRATION OF FOODS

Introduction

Importance of concentration and dehydration; Various methods; Concept of water activity and sorption isotherms; Fundamentals of air-water vapour mixtures; Physico-chemical Changes caused by concentration and dehydration.

Evaporation

Properties of liquid for selection; Heat and mass balance on single and multiple effect evaporators; Types of evaporators.

Freeze Concentration

Applications, Advantages and disadvantages; Principles involved; Types of freeze concentrators.

Membrane Concentration Process

Fundamentals of membrane processing; Application of UF and RO Membranes; Properties of membranes; Types of UF and RO modules; Permeate flow calculations.

Drying of Liquid Foods

Methods of drying; Spray Drying: Stages involved, types of atomizers, types of spray dryers; powder removal methods, drying time calculation, two stage drying, factors affecting powder properties, instantiation; Drum Drying: Types of drum dryers, methods of feeding liquid, design of drum dryer.

Drying of solid foods

Drying process - constant rate period, falling rate period; mechanisms of moisture transfer; drying time calculations; factors affecting drying time; types of dryers.

Freeze Drying

Fundamentals of freeze drying; Freezing; Primary and secondary drying; Freeze-drying calculations; Types of freeze dryers.

Standards and quality control

Suggested Text Books & References

- Billet, Reinhard, "Evaporation Technology: Principles, Applications and Economics" VCH Publishers, 1989.
- Hansen, Robert, "Evaporation, Membrane Filtration and Spray Drying". North European Dairy Journal Denmark, 1985.
- Mact.arthy, D. "Concentration and Drying of Foods", Elsevier Applied Science, 1986.
- Kessler, H.G. "Food Engineering and Dairy Technology". V.A. Kessler, Germany, 1990.
- Barbosa - Canovas, V. and Vega - Mercado, H. "Dehydration of Foods", Champman and Hall, New York 1996.

FATS AND OIL PROCESSING

Introduction

Sources of fats and oils; Handling of oil bearing materials; Processing of oil sulphates; Food uses: Soaps and detergents; Paints and Polishes.

Physico-chemical Properties of Fats and Oils

Hydrolysis, esterification and related reactions; Other reactions involving carboxyl groups; Reactions in the fatty acid chain; Oiliness and viscosity; Physical thermal and electrical properties; Smoke, fire and flash point; Solubility, miscibility, emulsions and emulsifiers; Optical properties.

Sources, Utilization and Classification of Fats and Oils

Sources of commercial fats and oils; Utilization of commercial fats and oils; Classification of fats and oils; Non-conventional sources of edible and commercial oil: Composition and characteristics of major fats and oils.

Handling, Storage and Grading of Oils and Oil Bearing Materials

Deterioration in crude oil and oil bearing materials; Grading and evaluation: Handling and storage.

Processing of Oil Bearing Material

Rendering and trying out; Mechanical expression; Hydraulic pressing and expressing; Solvent extraction.

Processing of Oils and Fats

Physical and chemical refining; Hydrogenation process, plant and quality control in hydrogenation; Fractionation of oils and fats; Interesterification.

Food Use of Fats and Oils

Shortenings; Salad oils; Margarine; Use of confectionery products; Packaging and storage of oils and fat based foods; Standards and quality control.

Soaps and Detergents

Soap boiling; Semi boiled and cold processes; Continuous saponification; Transformation

of neat soap to finished forms; Manufacture of toiled soap bars and test methods; Theory of surface action; Surface active agents other than soap.

Paints and Polishes

Mechanisms of polymerization and drying; Materials; Manufactured products and their manufacturing operations.

By Products of Oil and Fat Processing in Industries

Food and non food uses of oilseed cakes and meals; Glycerine; Lecithin and other products.

Suggested Text Books and References

- Hamilton, R.J. and Bhati, A. "Fats and Oils Chemistry and Technology". Applied Science Publishers Ltd., 1980.
- Williams, K.A. "Oils, Fats and Fatty Foods". J. and A. Churchill Ltd .. London. 1986.
- Weiss, T.J., "Foods, Oils and Other Uses". AVI Publishing Co., 1970.
- Gillies, M.T. "Shortenings, Margarine and Food Oils". Noyes Data Corporation, 1974.
- Desrosiar, N.W. "Elements of Food Technology", AVI Publishing Co., 1977.
- Danial, Swam., "Bailey's Industrial Oil and Fat Products". John Wiley and Sons, 1989.

FISH PRESERVATION AND PROCESSING TECHNOLOGY

Introduction

Fishery resources; Fish as living animals; Physico-chemical characterization of fish; Causes of fish spoilage; Fundamentals of fish preservation; Major products and by products of fish.

Fresh Fish

Handling and transportation of fish at sea; Handling and transportation on land; Ship board refrigeration equipments; Cold chain.

Low Temperature Preservation of Fish

Products of chilled fish; Freezing of fish; Use of additives for freezing; IQF method; Packaging, storage and distribution of frozen fish; Thawing and drip losses; Freezing of tropical fish; Quality of frozen fish.

Cured and Smoked Fish

Salt curing of fish; Storage of salted fish; Quality of finished products; Production of cold smoke fish; Hot smoked fish and light salted and light smoked fish; Production of smoked fish using curing liquid.

Drying of Fish

Sun drying offish; Dehydration offish; Production of Balyk preparations; Freeze drying.

Thermal Processing of Fish

Types of canned fish; Canning offish; Spoilage of canned fish products and quality control.

Irradiation of Fish

Other Fish Products

Marinated and spiced fish; Caviar; Fish preserves; Fried fish; Soups; Baked fish; Jellied preparations from fishes.

By Products of Fish Industry

Oil, meal from fish; Industrial glue.

Microbiological Safety of Fishery Products

Suggested Text Books and References

- Govindan, T.K. "Fish Processing Technology". Oxford and IBH, 1985.
- Wheaton, F.W. and Lawson, T.R "Processing of Aquatic Food Products". John Wiley and Sons, 1985.
- Hall, G.M. "Fish Processing Technology". London Blackie Academic and Professional Publication, 1992.
- Gerasimov, G.V. and Antonova, MT. "Techno-Chemical Control of fish Processing Industry". Amerind Publishing Co. Pvt. Ltd., 1979.
- Borgess, G.H.O., Cutting, C.L., Lovern, J.A. and Waterman, U. "Fish Handling and Processing". Chemical Publishing Co., 1967.

CONVENIENCE FOODS AND BEVERAGES

Introduction

Importance of convenience foods and their types and historical developments

Production and Processing

Production and processing of easy to cook food like macaroni, noddles and vermicelli, breakfast and ready to eat(RTE) cereals, puffed rice, flaked rice, shredded and granular and sugar coated cereals and pulses

Condiments and Confections

Formulations, processing, packaging and storage of health, infant, energy and baby foods, and other specialty and fast foods

Structured and Textured Protein Foods

Production and storage of extruded ready to eat foods

Production of Alcoholic and Non-alcoholic Beverages

Production and processing of beer, wine, alcohol, whisky, coffee, tea, soft drinks, fruit beverages, sherbets etc., biochemical changes and nutritional qualities.

Suggested Text Books and References

- Donald, K. "Food Products Formulations",1975
- Choudhury, M.R. "Tea Industry and India",1978
- Matz, S.A. "Cereal Science and Technology", 1970
- Patt, G.c. "Fermented Foods of the World: A Dictionary and Guide",1987

PHYSICAL PROPERTIES OF FOOD & BIO-MATERIALS

Introduction

Importance of physical properties of bio-materials in various harvest and post harvest operations & design of machines.

Characterisation of Shape and Size of Irregular Bodies

Characterization of shape and size of irregular shaped bodies; geometric mean diameter, sphericity

Methods of determination of surface and specific surface area of process packs.

Gravimetric Properties

Determination of porosity, bulk density, true density of biological materials.

Rheological Properties of Biomaterials

Rheological behaviour of solids and liquid foods. Their classification, determination of rheological properties of visco-elastic materials in static and dynamic conditions, viscometry, mechanical damage its causes, detection & evaluation, contact stresses; Impact loading, Texture profile analysis.

Frictional Properties

Frictional properties angle of repose. Pressure distribution in granular materials.

Aerodynamic Properties

Aerodynamic properties of grains, terminal velocity, drag coefficient.

Optical Properties

Optical properties of bio-materials and applications, optical density & colour classification for solids & liquid foods and their application.

Electric Properties

Electric properties capacitance & resistance, dielectric constant & their application in various instruments and equipments.

Thermal Properties

Thermal conductivity, specific heat & thermal diffusivity of bio materials, and their importance in heating, cooling and drying of food materials.

Application of Physical Properties

Application of physical properties to processing, storage packaging and handling of food materials. Design considerations & selected examples of application.

Suggested Text Books & References

- Mohsenin, Nuri N, "Physical Properties of Plant and Animal Materials", Gordon and Breach, Science Publishers, N.Y., 1980.
- Mohsenin, Nuri N. "Thermal Properties of Foods and Agricultural Materials", Gordon and Breach Science Publishers, N.Y., 1980.

- Mohsenin, Nuri N. "Electrical and electro-magnetic radiation properties of Foods and Agricultural Materials", Gordon and Breach Science Publishers, N.Y., 1984.
- Rao M.A. and Rizvi, S.S.H. "Engineering Properties of Foods", Marcel Dekker, New York, 1986.

FOOD PLANT UTILITIES AND SANITATION

Introduction

Food plant utilities and their importance; Estimation of utilities and utility load diagram; Importance of food plant sanitation; Sanitation standards and their implementation.

Steam and Steam Generation

Properties of steam and steam generation process: steam generation equipment (boiler); Boiler type and their characteristics: Boiler accessories; Selection of boiler for food processing operations; Design of boiler vessel and boiler system: Performance of boilers and its evaluation; Energy conservation in boiler operation; Treatment of boiler feed water.

Water Treatment for Microbial Safety

Quality standards for water, processes and equipment for water treatment; Selection of water treatment processes.

Cleaning and Sanitation of Food Processing Plants and Equipments

The need for cleaning; Frequency of cleaning; Methods of cleaning and cleaning equipment: Cleaning agents (detergents); Cleaning in place systems and their application; Standards for clean surfaces; Sanitizing agents and agents and sanitization processes.

Waste Disposal and Treatment

Nature of the waste and effluent generated by various food industries; BOD analysis of gas transfer; Aerobic and an aerobic treatments of solid wastes and effluent; Reaction kinetics of the treatment processes; Design and selection of waste treatment systems.

Suggested Text Books and References

- Ballaney, P.L. "Thermal Engineering". Khanna publishers, New Delhi, 1995.
- Belan, F.I. "Water Treatment". Meer publishers. Moscow.
- Mecalff and Eddy. "Waste Water Engineering Treatment; Disposal, Reuse". Tata McGraw Hill Publication Co., New Delhi, 1987.

ANIMAL SCIENCE

Introduction

Livestock industry in India; Trends in development and contribution to national economy; Terms used in livestock production.

Physiology and Characteristics of Farm Animals

Climatic and environmental physiology of farm animals; Characteristics of indigenous exotic and cross bred farm animals.

Livestock

Management of livestock; Care housing and restraining of breeding bulls; Care and housing of calves and growing stocks; Care and housing of dairy cattle, buffaloes, sheep, swine and goat; Care and housing of down calves; Calving pens; Isolation and housing of sick farm animals.

Animal Feeding

Feed; Fodder processing and storage; Milk recording and chilling facility.

Poultry

Care; Housing; Hatchery and storage of feed.

Fisheries

Hatchery and stocking of various classes of fish; Storage of fish feeds.

Milk Processing

Plants; Location and engineering aspects.

Meat Processing

Plants, location and engineering aspects.

Suggested Text Books and References

- Prasad, Jagdish, "Principles and Practices of Dairy Farm Management". Kalyani Publishers, Ludhiana.
- Banerjee, c.c. "Text Book of Animal Husbandary". Calcutta Oxford Books Co., Shastri, N.S.K and Thomas, CK. "Farm Animal Management and Poultry

- Production", New Delhi. **PHI**.
- Singh, H. and Moore, K.N. "Livestock and Poultry Production". New Delhi, **PHI**.
- Indian Council of Agricultural Research. "Hand Book of Animal Husbandry".

DATABASE MANAGEMENT AND MICROPROCESSOR APPLICATIONS

Data Structure

Data and information; data, entities and entity sets; data attributes and relationships among data; metadata, records and database; fixed and variable length records

File Organization & Processing

File organization and access methods: sequential and indexed sequential file organization; direct file organization and random access; hashing

Database Management System (DBMS)

Types of database management system- hierarchical, network, relational and pseudo-relational; structured query language (SQL) and query by example (QBE)

Using Database Management Software

Planning and designing a database structure; types of fields; creating structure; entering and editing data; viewing and updating database; database rearrangement- indexing and sorting; information retrieval; query

Microprocessor

Introduction to microprocessors; 8, 16 and 32 bit micro-processor; bus structure- address, data and control busses; microprocessor based data acquisition and control instrumentations: transducers, signal conditioners, multilexers, A/D and D/A converters, memory, and interface with a computer

Process Control

Introduction to process control; process identification- disturbance, control and manipulative variables; control strategies- feed back feed forward, and feed back-feed forward controls; control laws- proportional(P), proportional-integral(PI) and proportional-integral-derivative (PID) control

Suggested Text Books & References

- Mazumdar, A.K. and Bhattacharya, P. "Introduction to Data Base Management Systems", McGraw Hill, 1997

- Gillenson, Mark L "DATABASE: Step by Step", Wiley Eastern Ltd., Delhi, 1985
- Tharp, Alan I. "File Organization and Processing", John Wiley & Sons, 1988
- Silberschatz, A., Korth H. and Sudarshan, "Data Base Management Systems", McGraw Hill, 1997
- Pal, A. "Microprocessors: Principles & Applications", Tata McGraw Hill, 1997
- George Stephanopolous, "Chemical Process Control", Prentice Hall of India, 1990

MARKETING MANAGEMENT

Introduction

Core concepts of marketing - needs, wants, demand, products, value, cost, satisfaction, exchange, transactions, relationships, markets, marketing and marketers; Marketing management and competing concepts under which organizations conduct their marketing activities.

Consumer Market of Agro/Food Products

Model of consumer behaviour; Determinants consumer behaviour and consumer bank process; Evolution of food market from commodity to graded product market.

Business Market of Agro Products

Business market - industrial, reseller and government; Business buying process and influencers thereof.

Identifying Market Segments and Selecting Target Markets

Market segmentation - concept, pattern, procedure, basis and benefits; Market targeting - evaluating segments, selecting the segments; Positioning the market offer - product differentiation developing a positioning strategy, and communicating the positioning strategy.

Marketing Strategy

Marketing mix for agro products – product, price, promotion and physical distribution; Developing optimal marketing mix.

Marketing Plan

Marketing plan for agro products - concept and components; Developing marketing plan for the benefits of customers and firms; Marketing plan to optimize resource allocation.

Product management

The new product and the development thereof; the product life cycle; Marketing mix for various stages of product life cycle.

Sales Management

Designing marketing promotion mix for agro products; Managing sales force; Direct marketing and personal marketing; The communication process - elements and media planning.

Export Market for Agro Products

International trade in agro products and WTO; Developing marketing mix for global trade; India's Exim Policy for agro products.

Suggested Text Books and References

- Majumdar, Ramanuj. "Product Management in India". Prentice Hall, 1996.
- Philip. "Marketing Management - Analysis, Planning Implementation and Control Prentice Hall, 1996.
- Sengupta Subrota. "Brand Positioning Strategies for Competitive Advantage". Tata McGraw Hill 1990.
- Mahendra Mohan "Advertising Management Concepts and Cases". Tata McGraw Hill. 1990.
- Ludlow. Ron, and Panton, Fergus. "The Essence of Effective Communication". Prentice Hall 1995

ENGINEERING ECONOMY AND PROJECT PLANNING

Introduction

Economics, definition; Engineering economics; Industrial economics; Utility; Law substitution; Value and pricing goods and wealths; Wants; Demands and Supply; The law of demand and supply; Elasticity of demand; Factors effecting and elasticity of demand.

Money; Value of money; Velocity of circulation; Inflation; Hyper inflation; Deflation; Trade cycle; Banks, types of banks; Commercial banks; Central Banks; Industrial Banks; Agricultural Banks; Exchange banks; IMF; World Bank.

Terminology and Cash Flow Diagram

Time value of money; Engineering economy factors and their use; Economic analysis, present worth; Equivalent uniform annual worth; Capitalized cost; Internal rate of return;

Economic analysis of operating plans; Profit versus Loss cost comparison; Break even analysis; Compound interest calculations; The uniform annual cost method; Equal service period requirement.

Replacement Studies

Determination of replacement; Salvage value; Book value; replacement theories; Cost benefit and pay back analysis; Capital budgeting.

Depreciation

Purpose of depreciation; Type; Economic life; Depreciation methods; Straight line method: Declining balance method; Sum of years digits methods; Sinking fund formula; Service output method; Selection of depreciation method; Depletion; Valuation; Determination of property life from limitations in the use of mortality data.

Forecasting

Forecasting in operations; Forecasting and operations; Sub systems; Characteristics of demand overtime; Dependent versus independent demand; Forecast error; Intuitive or formal approaches; Useful forecasting models; Quantitative models; Time series quantitative models; Exponential smoothing; Double exponential smoothing; Regression analysis; Selection of the forecasting model; Behavioral dimensions of forecasting.

Network Analysis

PERT and CPM; The terminology of networks; Shortest path problem; Minimum spanning tree problem; Maximum flow problem; Minimum cost flow problem; Network simplex method; Project planning and control with PERT CPM.

Inventory Control

Demand and control systems; Characteristics inventory concepts costs; Inventory modelling; Deterministic inventory models; Stochastic inventory models; Applications in behavioral pit falls in inventory control.

Suggested Text Books and References

- Dagavino, E.P. "Engineering Economy". Seventh Edition.
- Chaby, S.N. "Productions and Operations Management". Tata McGraw Hill, 1980.
- Riggs, J.L. "Engineering Economics". McGraw Hill, 1972.
- Taylor, G.A. "Managerial and Engineering Economy". East West Press, 1971.
- Vanhorne, J.C. "Financial Management and Policy". Prentice Hall of India, 1974.
- Makvidiki, S., Wheelwright, S.C. and Mcgee, V.E. "Forecasting methods and Applications". John Wiley and Sons.

UTILIZATION OF ELECTRICAL ENERGY IN AGRICULTURE

Introduction

Use of electrical energy in agriculture; Electromechanical energy conversion.

Electrical Motors

Introduction; Various types of motors; d.c. motors; Different types of d.c. motors; Speed control of d.c. motors; Automatic control of d.c. motors; Testing of motors and their characteristics.

Three phase induction motor- general; squirrel cage and slip ring motors; Characteristics of induction motor; Starting of squirrel cage induction motor; Starting of slip ring induction motor; Speed control of induction motor and their characteristics.

Selection - Selection of motors for different applications; Duty cycles and efficiency.

Use of Electrical Energy

Electrical heating - Resistance heating; Inductive heating; Electric furnaces; Infrared heating; Heating of buildings; Resistant wires; Design of resistance elements.

Welding - Resistance welding; arc welding; a.c. or d.c. welding; a.c. welders; d.c. welding machines; maintenance of welding machines.

Lighting - Definition; Illumination and luminance; Reflection; Colour of objects; Polar luminous intensity diagram; Effect of voltage variation on lamps; Design of lighting installations; Recommended levels of illumination; Street lighting; Flood lighting.

Distribution of Electricity

Load estimation - Layout and distribution of electric power; Radial and ring main system; d.c. 3-phase wire system; Different types of distributors.

Wiring - General; radial versus ring wiring; selection of wire sizes; Load centre; Earthing; Switching and protection.

Tariff on Electrical Power

Cost of electricity; Energy audit; Effect of power factor on the system; Cost of renewals.

Servicing of Electrical Equipments

Fault diagnosis; Servicing and repair of motor windings; Commutators and other electric

equipment.

Rural Electrification

Rural electrification; photo-voltaic cells; Alternative electrical energy sources.

Selection of Drives

Special electrical appliances and controls used for dairy, poultry, processing and irrigation systems.

Suggested Text Books and References

- Soni, Gupta, and Bhatnagar, "A text book power System Engineering". Dhanpat Rai.
- Bhatia, S.L. "Handbook of Electrical Engineering". Khanna Publications.
- Bstown, R.H., "Farm Electrification". McGraw Hills, 1956.
- Taylor, a.p. "Utilization of Electrical Power". Wheeler Publications, 1990.
- Pratap, S. "Utilization of Electrical Power". S. Chand Publications, 1989.
- Uppal, S.L. "Wiring and Estimation of Electrical Work". Khanna Publications, 1989.

OPERATIONS MANAGEMENT

Introduction

Practical applications of operations management in project design, forecasting, aggregate planning, control of inventory systems, and quality control.

Capital Investment, Decision in Process Design

Introduction; Capital budgeting process; Pay back; Time value of money; Discounted cash flow methods; A systems approach with linear programming.

Replacement Analysis

Introduction; Various plant models; The concept of economic life; Decision tree; Benefit cost ratio for replacement alternatives.

Project Design

Introduction; Network design; Pert; Critical path methods; Scheduling with limited resources.

Facilities Layout

Introduction; Product and process layouts; Independent case study; Glover landing.

Facilities Location

Introduction; Factors which influence location decisions.

Pollution Control and its Impact on the Process

Introduction; Forms of pollution; Why has waste disposal got out of control; Waste disposal costs; Pollution prevention alternatives.

Forecasting by Exponential Smoothing

Major forecasting approaches; A model for irregular movements; Simple exponential smoothing; Model for trend and irregular movements; A model for seasonal and irregular movements; A model for trend seasonal and irregular movements; Generality of models; Uncertainty of the forecast.

Economic Forecasting

Simple linear regression; Non linear relationships; Multivariate regression analysis.

Aggregate Planning

Absorbing demand fluctuation is with overtime, Under time, Inventory and Subcontracting; Absorbing demand fluctuations with overtime, undertime, inventory, subcontracting and back orders; Absorbing demand fluctuations with overtime, inventory, hiring and layoff; Absorbing demand fluctuations with overtime, undertime, hiring, layoff, inventory and back costs with all factors being non linear; A heuristic model for production planning.

The Management and Control of Inventory Systems

A general framework for inventory models; Inventory costs; EOQ model; Quantity discounts; EOQ model with stock outs allowed; Inventory models under risk; Aggregate effects; Inventory systems.

Loading, Sequencing and Control

One machine; Flow shop; Static arrival pattern; SPT; Sequence dependent setup times jobs; $m = 2$ machine; Flow shop; Static arrival pattern; Minimization of total elapsed time; Static arrival pattern, minimization of total elapsed time; n jobs; m machines flow shop; Static arrival pattern; Minimization of total elapsed time; Case study; Cost scheduling

Quality Control

Where to inspect; Sampling risks and economics of sampling; Acceptance sampling by

variables; Process control.

Linear Programming and Simulation

Introduction; Transportation models; Assessment model; Mathematical programming; Simplex method; Dual simplex method; Simulation.

Suggested Text Books and References

- Shroder. "Operations Management". McGraw Hill, 1994.
- Monk. "Operations Management". McGraw Hill, 1993.
- Buffa. "Operations Management". McGraw Hill, 1990.

FOOD SCIENCE

Introduction

Definition of Food Science: Role of food science in augmenting food supplies; activities of food scientists; characteristics of Indian food industry.

Structure of Food

Physical structures of foods; appearance texture' and flavour of foods, and their; use in assessment of food quality.

Food Constituents

Water: water contents of foods, physical contents of water and ice, structure of water molecule and pure ice, association of water molecules, water, solute interaction, water-activity, solute mobility and food stability.

Carbohydrates: Structure and nomenclature of carbohydrates, carbohydrate, of major importance In foods; hydrolysis, dehydration and browning reactions.

Lipids: Definition and classification, role and use of lipids in food, hydrolytically and oxidative rancidity, emulsions.

Proteins: Type, structure and terminology, functional properties, distribution of proteins in various foods, denaturation of proteins, unconventional sources of proteins.

Enzymes

Enzyme nomenclature definitions, kinematics of enzyme activity, factors effecting enzyme

activity, enzyme inhibitors, immobilized enzymes in food processing.

Nutritional Aspects of Food

Nutritional value of common foods; recommended dietary allowances for various nutrients: protein quality; vitamins and minerals; common nutritional disorders; changes in nutritive values of foods during processing; optimization of nutrient retention; food fortification. enrichment restoration and supplementation.

Pigments

Classification of natural pigments of foods; effect of processing on natural pigments; synthetic colours permitted in foods; regulatory aspects of food colours.

Flavour of Foods

Sensation of taste and aroma; natural and synthetic flavours; flavour intensifiers; assessment of flavours.

Microorganisms and Food

Classification and identification of micro organisms; factors effecting growth of micro organisms, kinetics of microbial growth and inactivation; sources of microbial contamination of foods; important micro organisms causing food spoilage; food poisoning; microbial production of ethanol and acetic acid.

Food Additives

Definitions; functional classification.

Food Laws, Food Standards and Food Safety

Indian food laws and their enforcing agencies; food standards, their role and maintenance in food industry; food adulteration, its causes; common adulteration and methods of detection.

Suggested list of experiments

- Determination of proximate composition of foods.
- Determination of acidity and pH.
- Determination of vitamin C content.
- Determination of total and reducing sugars.
- Determination of beta carotene content.
- Estimation of Ca/P content of food.
- Determination of peroxide value of food and free fatty acid content.
- Determination of enzyme activity.

- Alcoholic/acidic fermentation of food by microorganisms.
- Determination of total plate count.
- Determination of thermal death time of enzyme.
- Determination of calorific value of food.
- Sensory evaluation of a food.

Suggest Text Books and References

- Potter, N.N. "Food Science", The A VI Publishing Company, 1986.
- Desrosier, N.W. and Desrosier, J.N. "The technology of food preservation". The AVI Publishing Company, 1977.
- Fennema, O.R. "Food Chemistry", Marcel Dekhar. 1976.
- Frazier, W.C. "Food Microbiology". McGraw Hill Book Company.

OPEN ELECTIVES

(Syllabus of some of the Open Electives is mentioned in the subsequent pages, the student may take any other subject being taught in other branches of engineering as an Open Elective

1. Operation Research
2. Operation Research Technique
3. Optimization Methods
4. Reliability Engineering
5. Statistical Methods in Engineering
6. Advanced Engineering Systems
7. Human Values
8. Science Technology and Society
9. Science and Religion
10. Industrial Psychology
11. Energy Management

OPERATIONS RESEARCH

Definitions

Definitions and meaning of O.R. Nature and Scope of O.R. in agriculture and food engineering. Features and decision making in O.R. Principles of modelling, its classification. properties and advantages of good models.

Linear Programming

Definition and application of LPP; mathematical formulation for maximization of L.P.P. for their graphical and simplex method solution, revised simplex method, duality theory, post optimality analysis, transportation problems formulation and their solution assignment models and their solution.

Computer Applications

LPP project scheduling and management by PERT and CPM, queuing theory. PERT/CPM, their definition, techniques and evaluation. Planning of various projects and their solution with the help of computer. Integer programming-introduction, the branch and bound techniques, functions with N possible values, and zero-one programming.

Non-linear programming-Introduction, Kuhn-Tucker Condition-non-negative-quadratic programming, Wolfe's method, Beale's method, separate able convex programming. Fibonacci and golden section search.

Introduction to Dynamic Programming and Simulation

The recursive equation approach, computational procedure, solution of L.P.P. by Dynamic programming, simulation model, monte carlo technique, simulation languages, techniques applied to inventory and queuing problem. Lagrange Multipliers and Kuhn-Tucker condition.

Assignment

Balanced and unbalanced assignment problems and their solution.

Sequencing

Sequencing with 2.3 and m-machines with n jobs and their solution;

Inventory Management

Inventory its control and management economics lot size formula and inventory management under finite rate of replenishment, control considering shortages, various models and considerations under unknown demand.

Replacement

Techniques of replacement of items when value of money remain constraint and value of money decreases with time. Replacement of items which fails completely.

Suggested Text Books and References

- Revinchen, A., Phillips, D.T. and Solberg, J.J. "Operations Research-Principles and

- Practices" John Willey and Sons, New-York, 1987.
- Taha, J.A. "Operations Research-An Introduction", Me Millan Publishing Co.Inc., New York, I 996.
- Swaroop, Kanti, Gupta P.K and Manmohan, "Operations Research", Sultan Chan & Sons, 5th Ed, 1989.
- Hiller and Liberman, "Operations Research", McGraw Hill, NY, 1995.

OPERATION RESEARCH TECHNIQUE

Introduction: History of operation research, nature and scope of operations research, Allocation, assignment and transportation models.

Liner Programming: Mathematical formulation of the problem Graphical solution methods, Mathematical solution of L-P problems, Matrix formulation of general linear programming problems. Simplex method: algorithm and computational procedures, Two phase simplex method, Problem.

Game Theory: Introduction, Two persons zero sum games, The maxmini and Minimax principles.

Integer Programming: Formulation and solution of integer programming problems.

Suggested Text Books & References

- Fox, R.L "Optimization methods for Engineering design". Addison Wesley USA., 1971.
- Kambo, N.S. "Mathematical programming technique". Affiliated East West Press, New Delhi, 1984.
- Rao, S.S "Optimization Theory and Application", Wiley Eastern, New Delhi., 1978.
- Winston, Wayle L. "Operations research applications and algorithms", PWS Kent publishing company.

OPTIMIZATION METHODS

Introduction: Historical development, engineering application of optimization, Formulation of design problems as a mathematical programming problems, Classification of optimization problems.

Linear Programming: Simplex methods, Revised simplex method, Duality in linear programming, post optimality analysis, Transportation and assignment problems.

Non Linear Programming: Unconstrained optimization techniques, Direct search

methods, Descent methods, Constrained optimization, Direct and Indirect methods.

Dynamic Programming: Introduction, multi decision process, computational procedure.

Suggested Text Books & References

- Haddley, G. "Linear Programming".
- Fox, R.L. "Optimization Methods for Engineering Design". Addison Wesley USA., 1971,
- Kambo, N.S. "Mathematical Programming Technique" .. Affiliated East West Press, New Delhi,
- Rao, S.S. "Optimization Theory and Application", Wiley Eastern, New Delhi., 1978.

RELIABILITY ENGINEERING

Introduction: Definitions and CO1111'pb, Reliability. Probability, Impossible and certain events. Failure-Data and its analysis, Hazard rate and Failure density, Reliability in terms of hazard rate, Failure density in other situations.

Hazard Models: Types of distribution and standard deviation and variance, Expectations Conditional probabilities.

System Reliability: Series, parallel and mixed configurations, Methods of solving complex systems.

Reliability Improvement: Types of redundancies, Reliability allocation for a series system, Optimization Reliability - cost Trade-off.

Suggested Text Books & References

- Srinath, L.S. "Reliability Engineering", Affiliated East-West Press Limited, New Delhi, 1991.
- Roy Billington and Ronald N.Allan, "Reliability Evaluation of Engineering systems, Concepts and Techniques", Pitman Advanced Publishing Co., 1983.
- Govil, A.K. "Reliability Engineering", Tata McGraw Hill, New Delhi., 1983.
- Balagurusamy, E. "Reliability Engineering", Tata McGraw Hill, New Delhi, 1984.

STATISTICAL METHODS IN ENGINEERING

Fundamentals of statistics, Measure of valuabiality, mean deviation, quantity deviation, coefficient of deviation, Skewness, Moments about mean in terms of moment.

Elementary probability theory, conditional probability, Bay's theorem, Stochastic variety and Mathematical expectation, Applications.

Probability distribution and frequency distributions, Discrete and Continuous distributions, Probability density function, Moment generating function, Binomial, Poisson and Normal distribution and applications.

Relationship between variables. Bivariate distribution, line of regression, coefficient of correlation, standard error of estimates, significance of coefficient of correlation, standard error of estimates.

Variance of sum and difference of variable, statistical test of significance, sampling distribution, standard error, testing of hypothesis, Chi-square test, Student T -test, variance ratio test. Fisher's Z-test.

Analysis of variance. One way Classification, Two way classification & application. Suggested Text Books & References

- Chesson. A. "Industrial Statistic", Duncan. D.B. Taraporevate Sons & Co. Bombay.
- Nath, Pran "Statistics and Reliability for Engineering", Tara Printing works Varanasi.
- Hald A., "Statistical theory with Engineering applications" John and Sons. Inc.
- Savage. Leonard, "Foundation of Statistics" John Willey & Sons. Inc.

ADVANCED ENGINEERING SYSTEMS

Equation of motion for simple physical systems. Mechanical, Electrical, and Electromechanical systems. Equations of motion for simple heat, conduction and fluid systems. Analogies. Equations of motion for mechanical system in two and three dimensions. Dynamic response of first order and second order systems. Forced Oscillations of elementary systems. Dynamic stability of compound systems. Total response of compound systems. Fundamentals of control system analysis.

Reference

- Cannon, Robert H., "Dynamics of Physical systems", McGraw Hill Kngakusha

HUMAN VALUES

The objective of the course is an exploration of human values which go into making a 'good' human being, a 'good' human society and a 'good' life. The context is the work life and the personal life of modern Indian professionals.

1. The value-crisis in the contemporary Indian Society.
2. The nature of values: the value spectrum for a 'good' life
3. The Indian system of values.
4. Material development and its values: the challenge of science and technology
5. Psychological values: integrated personality; mental health
6. Societal values: the modern search for a 'good' society; justice, democracy, rule of law; values in the Indian constitution
7. Aesthetic values: perception and enjoyment of beauty
8. Moral and ethical values; nature of moral judgments; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.
9. Work ethics; professional ethics.
10. Spiritual values; different concepts; secular spirituality.
11. Relative and absolute values.
12. Human values: humanism and human values; human rights; human values as freedom, creativity, love and wisdom.
13. Management by values: professional excellence; inter-personal relationships at work place; leadership and team building; conflict resolution and stress management; management of power.

SCIENCE TECHNOLOGY AND SOCIETY

It will be innovative course dealing with social, human and ethical implications of engineering and technology, with special reference to the Indian situation. Its three main components are:

- (i) Social and Cultural history of technology,
- (ii) Social and Human critiques of technology,
- (iii) Engineering Ethics and Professional Ethics.

The proposed course structure is as follow:

1. Science, Technology and Engineering, as knowledge and as social and professional activities.
2. Inter-relationship of technology growth and social, economic and cultural growth; historical perspective.
3. Ancient, medieval and modern technology/Industrial revolution and its impact. The Indian Science and Technology.
4. Social and human critiques of technology: Mumford and Ellul.
5. Rapid technological growth and depletion of resources. Reports of the club of Rome. Limits to growth; sustainable development.
6. Energy crisis; renewable energy resources.
7. environmental degradation and pollution. Eco-friendly technologies. Environmental

regulations. Environmental ethics.

8. technology and the arms race. The nuclear threat.
9. appropriate technology movement Schumacher; later developments.
10. Technology and the developing nations. Problems of technology transfer. Technology assessment/impact analysis.
11. Human operator in engineering projects and industries Problems of man machine interaction. Impact of assembly line and automation. Human centred technology.
12. Industrial hazards and safety. Safety regulations. Safety engineering.
13. Politics and technology. Authoritarian versus democratic control of technology. Social and ethical audit of industrial organisations.
14. Engineering profession. Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and Ethical responsibilities of the engineer. Codes of professional ethics. Whistle blowing and beyond. Case studies.