

Syllabus – 2016

B.Tech (Agricultural Engineering)



Kelappaji College of Agricultural Engineering and Technology

Kerala Agricultural University

Tavanur 679 573

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Introduction

Agricultural Engineering incorporates many science disciplines and technology practices to the efficient production and processing of food, feed, fibre and fuels. It involves disciplines like mechanical engineering (agricultural machinery and automated machine systems), civil engineering, computer science, electrical engineering, soil science (crop nutrient and fertilization, etc.), environmental sciences (drainage and irrigation), plant biology (seeding and plant growth management), animal science (farm animals and housing) and much more.

The Bachelor of Technology degree in Agricultural Engineering provides a technical program focused on applying advancements in engineering technology to an agricultural and environmentally challenged society. Agriculture engineers find better ways to reduce crop loss from field damage, during handling, sorting, packing and processing. The warehousing of food and fibre are an important part of the agriculture industry. The agricultural engineer is the person who plans the heating, cooling, ventilation, postharvest handling, logistics and more.

Precision farming is a necessity. Today all the ramifications of a high-tech society beckon us to apply new technologies with speed and accuracy. Agriculture is feeding an ever growing world population with better quality food. The means to produce, ship and protect this food supply requires people who can implement and utilize these technologies successfully. The agricultural engineer obtains training in design and engineering problem solving based on an understanding of engineering sciences including mathematics, physics and biology. They must also have skills in computers, communication, teamwork and instrumentation. The feature distinguishing agricultural engineers from other engineers is their interest and commitment to solving agricultural problems

Engineering and technological needs demand highly trained agricultural engineers, equipped with knowledge, skills and practices of engineering technology with full appreciation of biosciences to handle the challenges before them. Courses and curricula call for revisions – skills of shop, drawing board, field surveys moderated in order to create room for computer use, information technology, GIS, computer aided design and computer aided manufacture, even understanding robotics and its application in hazardous situations in agriculture and allied activities.

The earlier curriculum was aimed at supporting the farming system, whereas the present one gives emphasis to sustaining it.

Organization of new Curriculum

The curriculum constitutes 132 fixed credit loads from different disciplines and 9 credits of electives from Agricultural Engineering courses. The student will be required to have a Project of 10 credit hours and a Seminar of one credit hour. The present proposal suggests an experiential form of practical training. It is recommended that there should be In-plant training for a period equivalent to one semester or two trainings of each (20 credits). Two Skill Development Trainings of 5 credits each and an Educational Tour carrying 2 credits. Thus the total credit load for the entire course is fixed at 184 credits.

The recommended new curriculum includes courses on computer programming, data structures, CAD / CAM drawing, entrepreneurship development, communication skills, agri-business management. The basic engineering and agricultural engineering courses have been modified taking into account the technological developments, that have taken place during the last decade. Further, the elective courses and the in-plant-training introduced will infuse greater confidence and improve the employment opportunities of the agricultural engineering graduates.

Method of Course Coding

The following course coding method was adopted to easily identify the courses run by various departments in different semesters.

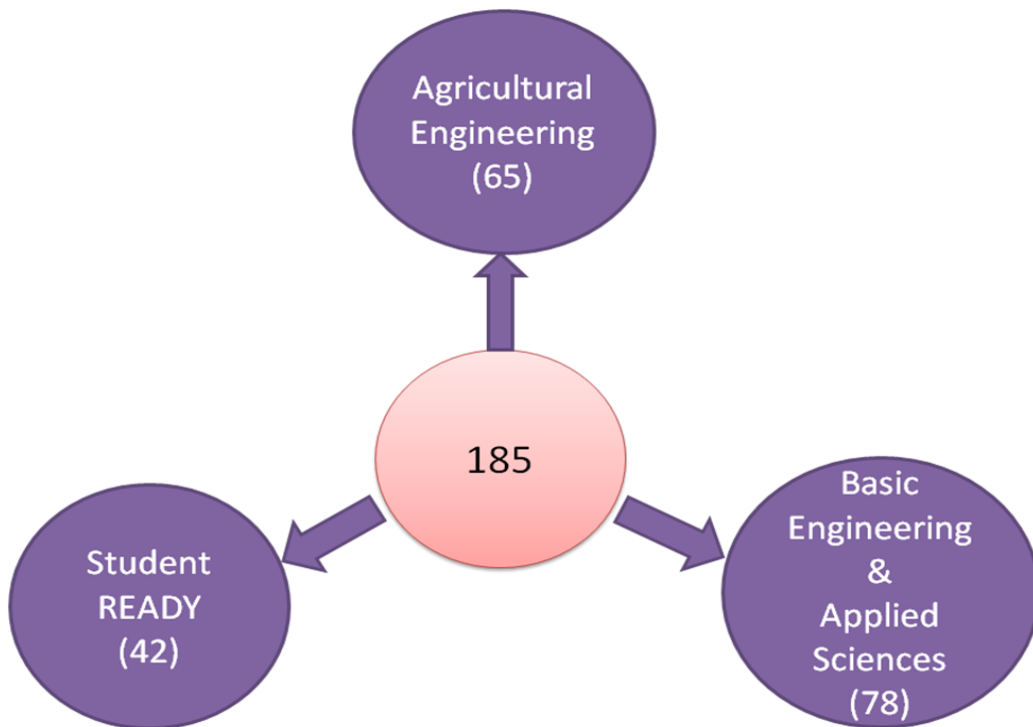
A four letter for department identification tag followed by a four-digit number designates each course. The first digit indicates the year, second for semester and third and fourth jointly indicates the number of the course offered by that department.

The department identification tags are:

Fpme. : Farm Power Machinery and Energy
Iden. : Irrigation and Drainage Engineering
Lwre. : Land and Water Resource Conservation Engineering
Fape. : Food & Agricultural Process Engineering
Sacs. : Supportive and Allied Courses of Studies.
Supportive and Allied Courses are indicated by the course name itself.

Digit 1 : Year to which the course is attached
Digit 2 : The semester to which the course is attended
Digit 3&4 : The serial number of the course offered by a specific department in a particular semester

Example : Fpme.1111 means a course run by Farm Power Machinery and Energy Department in the Ist Year Ist Semester 11th Course for B. Tech course.



Distribution of credits across major disciplines

DISCIPLINE –WISE COURSES

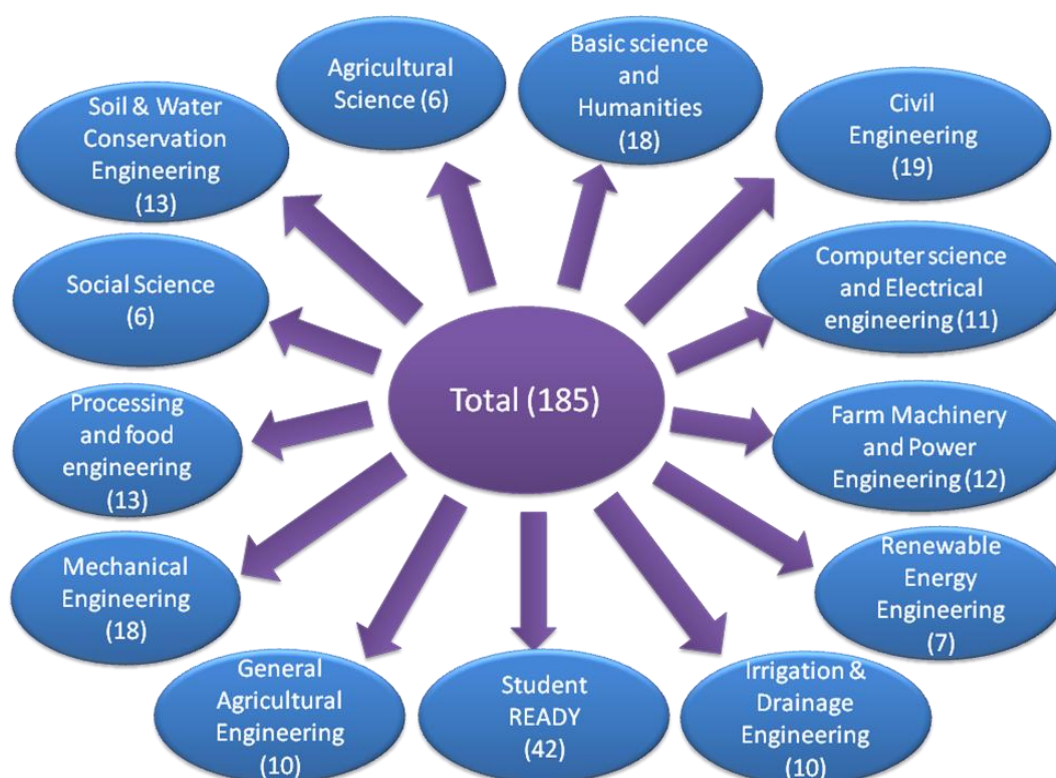
The major disciplines are further subdivided into minor disciplines and the courses are allotted as below.

Major discipline	Minor discipline	Courses	Credit
Agricultural Engineering (65)	Farm Machinery and Power Engineering (12)	Farm Machinery and Equipment-I (Fpme. 3110)	3 (2+1)
		Farm Machinery and Equipment-II (Fpme. 3213)	3 (2+1)
		Tractor and Farm Machinery Operation and Maintenance-I (Fpme. 3112)	1 (0+1)
		Tractor and Farm Machinery Operation and Maintenance-II (Fpme. 3214)	1 (0+1)
		Tractor Systems and Controls (Fpme. 3109)	3 (2+1)
		Ergonomics in Farm Machinery (Fpme. 3216)	1 (1+0)
		Sub Total	12 (7+5)
	Renewable Energy Engineering (7)	Bio- Energy Systems: Design and Application (Fpme. 3111)	2 (1+1)
		Energy Technology for Renewable Power production(Fpme. 3215)	2 (2+0)
		Fundamentals of Renewable Energy Sources (Fpme. 2208)	3 (2+1)
		Sub Total	7 (5+2)
	Irrigation & Drainage Engineering (10)	Sprinkler and Micro Irrigation Systems (Iden. 3107)	2 (1+1)
		Drainage Engineering (Iden. 3108)	2 (1+1)
		Ground Water, Wells and Pumps (Iden. 3209)	3 (2+1)
		Irrigation Engineering (Iden. 2206)	3 (2+1)
		Sub Total	10 (6+4)
	Soil & Water Conservation Engineering (13)	Watershed Hydrology (Lwre. 2104)	3 (2+1)
		Water Harvesting and Soil Conservation Structures (Lwre. 3107)	3 (2+1)
		Watershed Planning and Management (Lwre. 3208)	2 (1+1)
		Remote Sensing and GIS Applications (Lwre. 3209)	2 (1+1)
		Soil and Water Conservation Engineering (Lwre. 2206)	3 (2+1)
		Sub Total	13 (8+5)

Major discipline	Minor discipline	Courses	Credit	
	Processing and Food Engineering (13)	Agricultural Structures and Environmental Control (Fape. 3104)	3 (2+1)	
		Dairy and Food Engineering (Fape. 3207)	3 (2+1)	
		Post-Harvest Engineering of Cereals, Pulses and Oil Seeds (Fape. 2102)	3 (2+1)	
		Engineering Properties of Agricultural Produce (Fape. 1101)	2 (1+1)	
		Post-Harvest Engineering of Horticultural Crops (Fape. 3206)	2 (1+1)	
		Sub Total	13 (8+5)	
	General Agricultural Engineering (10)	Electives	9 (6+3)	
		Seminar (Semr. 4201)	1 (0+1)	
		Sub Total	10 (6+4)	
			Total	65
	Basic Engineering & Applied Sciences (78)	Civil Engineering (19)	Building Construction and Cost Estimation (Iden. 2104)	2 (2+0)
			Design of Structures (Iden. 2205)	2 (1+1)
			Engineering Drawing (Lwre. 1101)	1 (0+1)
Engineering Mechanics (Iden. 1101)			3 (2+1)	
Fluid Mechanics and Open Channel Hydraulics (Iden. 1202)			3 (2+1)	
Surveying and Leveling (Lwre. 1203)			3 (1+2)	
Strength of Materials (Iden. 1203)			2 (1+1)	
Soil Mechanics (Lwre. 2205)			3 (2+1)	
Sub Total		19 (11+8)		
Mechanical Engineering (18)		Auto CAD Applications (Fpme. 2106)	2 (0+2)	
		Heat and Mass Transfer (Fape. 2203)	2 (2+0)	
		Machine Design (Fpme. 2104)	2 (2+0)	
		Machine Drawing (Fpme. 1203)	1 (0+1)	
		Theory of Machines (Fpme. 1202)	2 (2+0)	
		Thermodynamics and Automotive Engines (Fpme. 2207)	3 (2+1)	
		Refrigeration and Air Conditioning (Fape. 3105)	3 (2+1)	
		Workshop Technology and Practices (Fpme. 1201)	3 (1+2)	
		Sub Total	18 (11+7)	

Major discipline	Minor discipline	Courses	Credit
	Computer Science & Electrical Engineering (11)	Computers Programming and Data Structures (Sacs. 3214)	3 (1+2)
		Web Designing and Internet Applications (Sacs. 2111)	2 (1+1)
		Electrical Machines and Power Utilization (Fpme. 2105)	3 (2+1)
		Applied Electronics and Instrumentation (Sacs. 2213)	3 (2+1)
		Sub Total	11 (6+5)
	Basic Sciences and Humanities (18)	Engineering Mathematics-I (Sacs. 1101)	3 (2+1)
		Engineering Chemistry (Sacs. 1103)	3 (2+1)
		Engineering Mathematics-II (Sacs. 1206)	3 (2+1)
		Engineering Mathematics-III (Sacs. 2110)	3 (2+1)
		Engineering Physics (Sacs. 1102)	3 (2+1)
		Physical Education and Yoga Practice (Sacs. 1209)	0 (0+1*)
		Communication skills and personality development (Sacs. 2112)	2 (1+1)
		Sub Total	18 (11+7)
	Social Sciences (6)	Entrepreneurship development and Business Management (Sacs. 1207)	3 (2+1)
		Environmental Studies and Disaster Management (Lwre. 1102)	3 (2+1)
		Sub Total	6 (4+2)
	Agricultural Sciences (6)	Principles of soil science (Sacs. 1104)	2 (2+0)
		Principles of Agronomy (Sacs. 1105)	2 (2+0)
		Principles of Horticultural crops and plant protection (Sacs. 1208)	2 (1+1)
		Sub Total	6 (5+1)
		Total	77
	Student READY (42)	20-Weeks Industrial Attachment/Internship (Iplt. 4101)	20 (0+20)
Skill Development Training-I (Skdt. 3101)		5 (0+5)	
Skill Development Training-II (Skdt. 4102)		5 (0+5)	

Major discipline	Minor discipline	Courses	Credit
		Educational Tour (3 Weeks, All India Tour) (Edtr. 4101)	2 (0+2)
		Project- Planning, Work and Report Writing (Pprw. 4201)	10 (0+10)
		Sub Total	42 (0+42)
GRAND TOTAL			185



Distribution of credits across minor disciplines

All the courses mentioned above are further distributed among the five statutory departments of the Faculty of Agricultural Engineering and Technology for its proper conduct.

COURSES OFFERED BY DIFFERENT DEPARTMENTS

(1) Farm Power Machinery and Energy

(a) Core Courses			
Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1.	Fpme. 1201	Workshop Technology and Practice	3 (1+2)
2.	Fpme. 1202	Theory of Machines	2 (2+0)
3.	Fpme. 1203	Machine Drawing	1 (0+1)
4.	Fpme. 2104	Machine Design	2 (2+0)
5.	Fpme. 2105	Electrical Machines and Power Utilization	3 (2+1)
6.	Fpme. 2106	Auto CAD Applications	2 (0+2)
7.	Fpme. 2207	Thermodynamics and Automotive Engines	3 (2+1)
8.	Fpme. 2208	Fundamentals of Renewable Energy Sources	3 (2+1)
9.	Fpme. 3109	Tractor systems and control	3 (2+1)
10.	Fpme. 3110	Farm Machinery and Equipment-I	3 (2+1)
11.	Fpme. 3111	Bio- Energy Systems: Design and Application	2 (1+1)
12.	Fpme. 3112	Tractor and Farm Machinery Operation and Maintenance-I	1 (0+1)
13.	Fpme. 3213	Farm Machinery and Equipment-II	3 (2+1)
14.	Fpme. 3214	Tractor and Farm Machinery Operation and Maintenance-II	1 (0+1)
15.	Fpme. 3215	Energy Technology for Renewable Power production.	2 (2+0)
16.	Fpme 3216	Ergonomics in Farm Machinery	1 (1+0)
Total credits			35 (21+14)

(b) Elective Courses

Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1.	Elfm. 4201	Mechanics of Tillage and Traction	3(2+1)
2.	Elfm. 4202	Farm Machinery Design and Production	3 (2+1)
3.	Elfm. 4203	Human Engineering and Safety	3 (2+1)
4.	Elfm. 4204	Tractor Design and Testing	3 (2+1)
5.	Elfm. 4205	Hydraulic Drives and Controls	3 (2+1)
6.	Elfm. 4206	Precision Agriculture and Management	3 (2+1)
7.	Elfm. 4207	Photovoltaic Technology and Systems	3(2+1)
8.	Elfm. 4208	Mechatronics	3 (2+1)
Total credits			24 (16+8)

(II) Irrigation and Drainage Engineering

(a) Core Courses			
Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1	Iden. 1101	Engineering Mechanics	3 (2+1)
2	Iden. 1202	Fluid Mechanics and Open Channel Hydraulics	3 (2+1)
3	Iden. 1203	Strength of Materials	2 (1+1)
4	Iden. 2104	Building Construction and Cost Estimation	2 (2+0)
5	Iden. 2205	Design of Structures	2 (1+1)
6	Iden. 2206	Irrigation Engineering	3 (2+1)
7	Iden. 3107	Sprinkler and Micro Irrigation Systems	2 (1+1)
8	Iden. 3108	Drainage Engineering	2 (1+1)
9	Iden. 3209	Ground Water, Wells and Pumps	3 (2+1)
Total credits			22 (14+8)

(b) Elective Courses

Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1.	Elid. 4201	Management of Canal Irrigation System	3 (2+1)
2.	Elid. 4202	Minor Irrigation and Command Area Development	3 (2+1)
3.	Elid. 4203	Water Quality and Management Measures	3 (2+1)
4.	Elid. 4204	Design and Maintenance of Greenhouse	3 (2+1)
5.	Elid. 4205	Landscape Irrigation Design and Management	3 (2+1)
6.	Elid. 4206	Application of Geospatial techniques in Water Resources	3 (2+1)
7.	Elid. 4207	Environmental Engineering	3 (2+1)
8.	Elid. 4208	Numerical Methods in Water Resources	3 (2+1)
9.	Elid. 4209	Irrigation Structures	3 (2+1)
10.	Elid. 4210	Climate change and use of Geoinformatics	3 (2+1)
Total credits			30 (20+10)

(III) Land and Water Resource conservation Engineering

(a) Core Courses			
Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1	Lwre. 1101	Engineering Drawing	1 (0+1)
2	Lwre. 1102	Environmental Studies and Disaster Management	3 (2+1)
3	Lwre. 1203	Surveying and Levelling	3 (1+2)
4	Lwre. 2104	Watershed Hydrology	3 (2+1)
5	Lwre. 2205	Soil Mechanics	3 (2+1)
6	Lwre. 2206	Soil and Water Conservation Engineering	3 (2+1)
7	Lwre. 3107	Water Harvesting and Soil Conservation Structures	3 (2+1)
8	Lwre. 3208	Watershed Planning and Management	2 (1+1)
9	Lwre. 3209	Remote Sensing and GIS Applications	2 (1+1)
Total credits			23 (13+10)

(b) Elective Courses

Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1.	Ellw. 4201	Floods and Control Measures	3 (2+1)
2.	Ellw. 4202	Wasteland Development	3 (2+1)
3.	Ellw. 4203	Information Technology for Land and Water Management	3 (2+1)
4.	Ellw. 4204	Precision Farming Techniques for Protected Cultivation	3 (2+1)
5.	Ellw. 4205	Water Quality and Management Measures	3 (2+1)
6.	Ellw. 4206	Applications of Plastic in Agriculture	3 (2+1)
7.	Ellw. 4207	Quantity Surveying and Valuation	3 (2+1)
Total credits			21 (14+7)

(IV) Food & Agricultural Process Engineering**(a) Core Courses**

Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1	Fape. 1101	Engineering Properties of Agricultural Produce	2 (1+1)
2	Fape. 2102	Post-Harvest Engineering of Cereals, Pulses and Oil Seeds	3 (2+1)
3	Fape. 2203	Heat and Mass Transfer	2 (2+0)
4	Fape. 3104	Agricultural Structures and Environmental Control	3 (2+1)
5	Fape. 3105	Refrigeration and Air Conditioning	3 (2+1)
6	Fape. 3206	Post Harvest Engineering of Horticultural Crops	2 (1+1)
7	Fape. 3207	Dairy and Food Engineering	3 (2+1)
Total credits			18 (12+6)

(b) Elective Courses

Sl. No.	Catalogue No.	Course Title	Credit Hrs.
1	Elfa. 4201	Food Quality and Safety	3 (2+1)
2	Elfa. 4202	Food Plant Design and Management	3 (2+1)
3	Elfa. 4203	Food Packaging Technology	3 (2+1)
4	Elfa. 4204	Development of Processed Products	3 (2+1)
5	Elfa. 4205	Process Equipment Design	3 (2+1)
6	Elfa. 4206	Agricultural By-Product Utilization	3 (2+1)
7	Elfa. 4207	Emerging Methods of Food Preservation	3 (2+1)
8	Elfa. 4208	Processing of Fish and Marine Products	3 (2+1)
9	Elfa. 4209	Processing of Spices and Plantation Crops	3 (2+1)
Total credits			18 (12+6)

(V) Supportive and Allied Courses of Studies

Sl.No.	Catalogue No.	Course Title	Credit Hrs.
1	Sacs. 1101	Engineering Mathematics-I	3 (2+1)
2	Sacs. 1102	Engineering Physics	3 (2+1)
3	Sacs. 1103	Engineering Chemistry	3 (2+1)
4	Sacs. 1104	Principles of soil science	2 (2+0)
5	Sacs. 1105	Principles of Agronomy	2 (2+0)
6	Sacs. 1206	Engineering Mathematics-II	3 (2+1)
7	Sacs. 1207	Entrepreneurship development and Business Management	3 (2+1)
8	Sacs. 1208	Principles of Horticultural crops and plant protection	2 (1+1)
9	Sacs. 1209	Physical Education and Yoga Practice	0 (0+1*)
10	Sacs. 2110	Engineering Mathematics-III	3 (2+1)
11	Sacs. 2111	Web Designing and Internet Applications	2 (1+1)
12	Sacs. 2112	Communication skills and personality development	2 (1+1)
13	Sacs. 2213	Applied Electronics and Instrumentation	3 (2+1)
14	Sacs. 3214	Computer programming and Data Structures	3 (1+2)
Total credits			35 (22+13)

DISTRIBUTION OF COURSES IN DIFFERENT SEMESTERS

Semester 1				
Sl.No.	Catalogue No.	Course Title	Credits	
			Theory	Practical
1.	Sacs. 1101	Engineering Mathematics-I	2	1
2.	Sacs. 1102	Engineering Physics	2	1
3.	Sacs. 1103	Engineering Chemistry	2	1
4.	Sacs. 1104	Principles of soil science	2	0
5.	Sacs. 1105	Principles of Agronomy	2	0
6.	Fape. 1101	Engineering Properties of Agricultural Produce	1	1
7.	Iden. 1101	Engineering Mechanics	2	1
8.	Lwre. 1101	Engineering Drawing	0	1
9.	Lwre. 1102	Environmental Studies and Disaster Management	2	1
Total Credits 22 (15+7)			15	7

Semester 2				
Sl.No.	Catalogue No.	Course Title	Credits	
			Theory	Practical
1.	Sacs. 1206	Engineering Mathematics-II	2	1
2.	Sacs. 1207	Entrepreneurship Development and Business Management	2	1
3.	Sacs. 1208	Principles of Horticultural Crops and Plant Protection	1	1
4.	Sacs. 1209	Physical Education and Yoga Practice	0	1*
5.	Fpme. 1201	Workshop Technology and Practices	1	2
6.	Fpme. 1202	Theory of Machines	2	0
7.	Fpme. 1203	Machine Drawing	0	1
8.	Iden. 1202	Fluid Mechanics and Open Channel Hydraulics	2	1
9.	Iden. 1203	Strength of Materials	1	1
10.	Lwre. 1203	Surveying and Levelling	1	2
Total Credits 23 (12+11)			12	11

Semester 3				
Sl.No.	Catalogue No.	Course Title	Credits	
			Theory	Practical
1.	Sacs. 2110	Engineering Mathematics-III	2	1
2.	Sacs. 2111	Web Designing and Internet Applications	1	1
3.	Sacs. 2112	Communication Skills and Personality Development	1	1
4.	Fape. 2102	Post Harvest Engineering of Cereals, Pulses and Oil Seeds	2	1

5.	Fpme. 2104	Machine Design	2	0
6.	Fpme. 2105	Electrical Machines and Power Utilization	2	1
7.	Fpme. 2106	Auto CAD Applications	0	2
8.	Iden. 2104	Building Construction and Cost Estimation	2	0
9.	Lwre. 2104	Watershed Hydrology	2	1
Total Credits 22 (14+8)			14	8

Semester 4				
Sl.No.	Catalogue No.	Course Title	Credits	
			Theory	Practical
1.	Sacs. 2213	Applied Electronics and Instrumentation	2	1
2.	Fape. 2203	Heat and Mass Transfer	2	0
3.	Fpme. 2207	Thermodynamics and Automotive Engines	2	1
4.	Fpme. 2208	Fundamentals of Renewable Energy Sources	2	1
5.	Iden. 2205	Design of Structures	1	1
6.	Iden. 2206	Irrigation Engineering	2	1
7.	Lwre. 2205	Soil Mechanics	2	1
8.	Lwre. 2206	Soil and Water Conservation Engineering	2	1
Total Credits 22 (15+7)			15	7
Skill Development Training- I in Summer break June-July after 4th Semester (Student READY)				

Semester 5				
Sl.No.	Catalogue No.	Course Title	Credits	
			Theory	Practical
1.	Fape. 3104	Agricultural Structures and Environmental Control	2	1
2.	Fape. 3105	Refrigeration and Air Conditioning	2	1
3.	Fpme. 3109	Tractor Systems and Controls	2	1
4.	Fpme. 3110	Farm Machinery and Equipment-I	2	1
5.	Fpme. 3111	Bio-Energy Systems: Design and Applications	1	1
6.	Fpme. 3112	Tractor and Farm Machinery Operation and Maintenance-I	0	1
7.	Iden. 3107	Sprinkler and Micro Irrigation Systems	1	1
8.	Iden. 3108	Drainage Engineering	1	1
9.	Lwre. 3107	Water Harvesting and Soil Conservation Structures	2	1
10.	Skdt. 3101	Skill Development Training-I (Student READY)	0	5
Total Credits 27 (13+14)			13	14

Semester 6					
Sl.No.	Catalogue No.	Course Title		Credits	
				Theory	Practical
1.	Sacs. 3214	Computer Programming and Data Structures		1	2
2.	Fape. 3206	Post Harvest Engineering of Horticultural Crops		1	1
3.	Fape. 3207	Dairy and Food Engineering		2	1
4.	Fpme. 3213	Farm Machinery and Equipment-II		2	1
5.	Fpme. 3214	Tractor and Farm Machinery Operation and Maintenance-II		0	1
6.	Fpme. 3215	Energy Technology for Renewable Power Production		2	0
7.	Fpme. 3216	Ergonomics in Farm Machinery		1	0
8.	Iden. 3209	Groundwater, Wells and Pumps		2	1
9.	Lwre. 3208	Watershed Planning and Management		1	1
10.	Lwre. 3209	Remote Sensing and GIS Applications		1	1
Total Credits 22 (13+9)				13	9
Skill Development Training- II in Summer break June-July after 6th Semester (Student READY)					

Semester 7 Student READY (Rural and Entrepreneurship Awareness Development Yojana)						
Sl.No.	Catalogue No.	Course Title			Credits	
					Theory	Practical
1.	Edtr. 4101	Educational Tour (3 Weeks, All India Tour)			0	2
2.	Iplt. 4101	20-Weeks Industrial Attachment/Internship (Student READY) (5 weeks per department)	Fpme	5	0	20
			Iden	5		
			Lwre	5		
			Fape	5		
3.	Skdt. 4101	Skill Development Training-II (Student READY)			0	5
Total Credits 27 (0+27)					0	27
Educational Tour during winter/January break						

Semester 8 Student READY (Rural and Entrepreneurship Awareness Development Yojana)						
Sl.No.	Catalogue No.	Course Title			Credits	
					Theory	Practical
1.	El. 42..	Elective course			2	1
2.	El. 42..	Elective course			2	1
3.	El. 42..	Elective course			2	1
4.	Pprw. 4201	Project –Planning, Work and Report Writing (Student READY)			0	10
5.	Semr. 4201	Seminar			0	1
Total Credits 20 (6+14)					6	14
Grand Total Credits 185 (88+97)					88	97

Department of Farm Power Machinery and Energy- Core Courses

Fpme.1201 Workshop Technology and Practice 3(1+2)

Objective

- To impart knowledge on various production and manufacturing processes and equipments.

Theory

Module I (5 Hours)

Safety in workshop. Plant layouts – types, advantages and disadvantages, factors influencing layouts. Mechanical and Technological properties types and description. Introduction to various carpentry tools, materials, seasoning, types of wood and their characteristics and operations in wood working. Introduction to smithy tools and operations.

Module II (4 Hours)

Introduction to welding, types of welding, oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Brazing and Soldering.

Module III (4 Hours)

Casting processes. Foundry tools, Pattern: types materials and allowances. Foundry sand and sand additives, types, uses and desired properties. Core and core prints. Moulding processes, types, advantages and disadvantages, casting defects.

Module IV (5 Hours)

Classification, constructional details of centre lathe, main accessories and attachments. Main operations and functions. Constructional details of standard shaper. Types of shaper and main operations. Types of drilling machines. Constructional details and main operations. Twist drill nomenclature. Types of Milling machines. Types of milling machines. Constructional details and main operations.

Practical

Study of types of wood and wooden joints and of carpentry tools. Preparation of simple carpentry joints: Cross half Lap joint, Dovetail joint, T- Lap joint. Jobs on carpentry – Plane to size. Introduction to welding equipment, processes tools, their use and precautions. Study of gas and arc welding. Jobs on arc welding - Straight line welding, Single ‘V’ butt joint welding, Lap joint, butt joint, T-Joint and corner joint in arc welding. Introduction to tools and measuring instruments for fitting. Jobs on sawing, filing and right angle fitting of MS Flat, Tongue and groove making, N-joint. Introduction to metal casting equipment, tools and their use. Study of foundry engineering: sand and allowances. Study of foundry tools. Jobs on foundry – Circular disc, Oval flange. Introduction to smithy tools and operations. Jobs on smithy – Square prism, Hexagonal prism. Introduction to machine shop machines and tools. Practical jobs on simple turning, step turning, taper turning. Introduction to tools and operations in sheet metal work. Making different types of sheet metal joints using G.I. sheets.

Lecture schedule

1. Introduction. Safety in workshop
2. Plant layouts – types, advantages and disadvantages, factors influencing layouts.
3. Mechanical and Technological properties types and description
4. Introduction to various carpentry tools, materials
5. Types of wood and their characteristics. Seasoning of wood, operations in wood working

6. Introduction to Smithy tools and operations
7. Introduction to welding. Types of welding, oxyacetylene gas welding
8. Types of flames, welding techniques and equipment
9. Principle of arc welding, equipment and tools
10. Mid examination
11. Foundry tools, Pattern: types materials and allowances.
12. Foundry sand and sand additives, types, uses and desired properties.
13. Core and core prints. Moulding processes, types, advantages and disadvantages, casting defects.
14. Lathe- Classification, Constructional details of centre lathe
15. Main accessories and attachments. Main operations and functions of centre lathes
16. Shaper machine- Constructional details of standard shaper. Types of shapers and main operations.
17. Types of drilling machines. Constructional details and main operations.
18. Practical Examination.

Practical schedule

1. Study of carpentry and welding tools.
2. Study of types of wood and wooden joints
3. Study of types of carpentry tools.
4. Preparation of simple carpentry joints: Cross half Lap joint.
5. Preparation of simple carpentry joints: Dovetail joint.
6. Preparation of simple carpentry joints: T- Lap joint.
7. Jobs on carpentry–Plane to size.
8. Introduction to welding equipment, processes tools, their use and precautions
9. Study of arc welding.
10. Study of gas welding
11. Jobs on arc welding - Straight line welding.
12. Jobs on arc welding - Single ‘V’ butt joint welding.
13. Jobs on arc welding - Lap joint,
14. Jobs on arc welding- Butt joint
15. Jobs on arc welding- T-Joint in arc welding
16. Jobs on arc welding- corner joint in arc welding
17. Introduction to tools for fitting.
18. Introduction to measuring instruments for fitting.
19. Jobs on sawing.
20. Filing and right angle fitting of MS Flat
21. Filing and right angle fitting of MS Flat.
22. Jobs on fitting–Tongue making.
23. Jobs on fitting- groove making.
24. Jobs on fitting–N-joint.
25. Practical in more complex fitting job
26. Introduction to smithy tools.
27. Introduction to smithy operations
28. Jobs on smithy–Square prism.
29. Jobs on smithy–Hexagonal prism.
30. Introduction to machine shop machines and tools
31. Practical jobs on simple turning.
32. Practical jobs on step turning
33. Practical job on taper turning

34. Introduction to tools and operations in sheet metal work
35. Making different types of sheet metal joints using G.I. sheets.
36. Practical Examination.

Suggested Readings

- Chapman W A J. 1989. Workshop Technology (Part I and II). Arnold Publishers (India) Pvt.Ltd., AB/9 Safdarjung Enclave, New Delhi.
- Hajra, Choudari S K and Bose S K. 1982. Elements of Workshop Technology (Vol.I and II). Media Promoters and Publishers Pvt.Ltd., Mumbai.
- Jayan P.R and Vaishak J. 2011. Workshop Practice-Vol-I, Practical Manual, Dept. of FPME, KCAET, Kerala Agricultural University Press, Mannuthy
- Jayan P.R and Vaishak J. 2011. Workshop Practice-Vol-II, Practical Manual, Dept. of FPME, KCAET, Kerala Agricultural University Press, Mannuthy
- Raghuwamsi B S. 1996. A Course in Workshop Technology (Vol.I and II). DhanpatRai and Sons, 1682 NaiDarak, New Delhi.

Fpme. 1202 Theory of Machines 2(2+0)

Objectives

- To provide knowledge on kinematics of selected mechanisms.
- To provide knowledge on theory and analysis of gears, Gear Trains and Synthesis of Mechanisms.
- To provide knowledge on different types of governors.

Theory

Module I

(9 Hours)

Elements, links, pairs, kinematics chain, and mechanisms. Classification of pairs and mechanisms. Lower and higher pairs. Four bar chain, slider crank chain and their inversions. Determination of velocity and acceleration using graphical (relative velocity and acceleration) method. Instantaneous centres.

Module II

(9 Hours)

Types of gears. Law of gearing, velocity of sliding between two teeth in mesh. Involute and cycloidal profile for gear teeth. Spur gear, nomenclature, interference and undercutting. Introduction to helical, spiral, bevel and worm gear. Simple, compound, reverted, and epicyclic trains. Determining velocity ratio by tabular method.

Module III

(9 Hours)

Turning moment diagrams, coefficient of fluctuation of speed and energy, weight of flywheel, flywheel applications. Belt drives, types of drives, belt materials. Length of belt, power transmitted, velocity ratio, belt size for flat and V belts. Effect of centrifugal tension, creep and slip on power transmission, Chain drives. Types of friction, laws of dry friction. Friction of pivots and collars. Single disc, multiple disc, and cone clutches. Rolling friction, anti-friction bearings.

Module IV

(9 Hours)

Types of governors. Constructional details and analysis of Watt, Porter, Proell governors. Effect of friction, controlling force curves. Sensitiveness, stability, hunting, iso-chronism, power and effort of a governor. Static and dynamic balancing. Balancing of rotating masses in one and different planes.

Lecture Schedule

1. Introduction
2. Elements, links and pairs
3. Kinematic chain and mechanism
4. Classification of pairs and mechanism
5. Lower pair and Higher pair
6. Four bar chain
7. Slider crank chain and their inversions
8. Determination of velocity and acceleration using graphical method (relative velocity and acceleration)
9. Instantaneous centres.
10. Types of gears and law of gearing
11. Velocity of sliding between two teeth in mesh
12. Involute and cycloidal profile for gear teeth
13. Spur gear nomenclature.
14. Interference and undercutting
15. Introduction to helical, spiral, bevel and worm gear
16. Simple and compound gear train
17. Reverted and epicyclic gear trains
18. Determining velocity ratio by tabular method
19. Turning moment diagrams
20. Mid Examination
21. Coefficient of fluctuation of speed and energy
22. Weight of flywheel. Flywheel applications
23. Belt drives, types of drives, belt materials.
24. Length of belt, power transmitted, velocity ratio, belt size for flat and V belts
25. Effect of centrifugal tension, creep and slip on power transmission
26. Chain drives
27. Types of friction, laws of dry friction
28. Friction of pivots and collars
29. Single disc, multiple disc, and cone clutches
30. Rolling friction, anti-friction bearings.
31. Types of governors.
32. Constructional details and analysis of Watt, Porter, Proell governors
33. Effect of friction, controlling force curves
34. Sensitiveness, stability, hunting, isochronism, power and effort of a governor
35. Static and dynamic balancing
36. Balancing of rotating masses in one and different planes.

Suggested Readings

- Ballaney P L. 1985. Theory of Machines. Khanna Publishers, 2-B Nath Market, NaiSarak, New Delhi.
- Bevan Thomas. 1984. Theory of Machines. CBS Publishers and Distributors, Delhi.
- Khurmi R S and Gupta J K. 1994. Theory of Machines. Eurasia Publishing House Pvt. Ltd., Ram Nagar, New Delhi.
- LalJagdish. 1991. Theory of Mechanisms and Machines. Metropolitan Book Co. Pvt.Ltd., 1 NetajiSubashMarg, New Delhi..

Rao J S and Dukkippatti R V. 1990.Mechanisms and Machine Theory. Wiley astern Ltd., New Delhi.

Rattan S B. 1993.Theory of Machines.Tata McGraw Hill Publishing Co. Ltd., 12/4 Asaf Ali Road, New Delhi.

Fpme. 1203Machine Drawing 1(0+1)

Objectives

- To understand the fundamental concepts of machine drawing
- To generate orthographic drawing of different machine parts
- To generate sectional drawing of simple machine parts

Practical

Module I

(9 Hours)

Introduction to Machine Drawing, Types of lines, Dimensioning, Different methods of dimensioning. Free hand sketching in machine drawing- Machine components, assembly and manufacturing drawing. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints.

Module II

(9 Hours)

Threaded fasteners -Nomenclature, Thread profiles, multi start threads, left and right hand threads, representation of threads,ISO metric thread and square thread forms. Square and hexagonal headed nuts and bolts. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Different types of keys-types, taper, rank taper, hollow saddle etc. Types of cotter and pin joints, Socket and spigot joint, sleeve and cotter joint and knuckle joint.

Practical Schedule

1. Dimensioning, Different Methods of dimensioning
2. Free hand sketching of machine components
3. Sectional drawing of simple machine parts
4. Introduction to riveted joints,
5. Forms of rivet heads, leak proof joints
6. Symbols for different types of welded joints
7. Forms of screw threads
8. Drawing of BSW, Square and Metric threads
9. Drawing of square headed and hexagonal headed nuts and bolts.
10. Drawing of Different types of lock nuts
11. Drawing of machine screws, cap screws and wood screws
12. Drawing of Different types of keys
13. Assembly drawing of simple machine parts
14. Introduction to cotter and pin joints
15. Drawing of Socket and spigot joint
16. Drawing sleeve and cotter joint
17. Drawing of knuckle joint
18. Practical Examination

Suggested Readings

- Anilkumar.K.N. 2005.Engineering Graphics.Adhyuthnarayan Publishers, Kottayam.
Bhat.N.D.2010. Elementary Engineering Drawing.Charotar Publishing House Pvt.Ltd. Anand.
Bhatt.N.D and Panchal.V.M. 2013.Machine Drawing.Charotar Publishing House Pvt.Ltd.Anand.
Narayana.K L and Kannaiah.P. 2010. Machine Drawing. ScitechPublications (India) Pvt. Ltd. Chennai.

Fpme. 2104Machine Design 2(2+0)

Objective

- To provide basic knowledge on the design consideration and methodology of various machine elements.

Theory

Module I

(11 Hours)

Meaning of design, Phases of design, design considerations. Common engineering materials and their mechanical properties. Types of loads and stresses, theories of failure, factor of safety, selection of allowable stress. Stress concentration. Elementary fatigue and creep aspects.

Module II

(7 Hours)

Cotter joints, knuckle joint and pinned joints, turnbuckle. Design of welded joints subjected to static loads. Design of threaded fasteners subjected to direct static loads, bolted joints loaded in shear and bolted joints subjected to eccentric loading.

Module III

(11 Hours)

Design of shafts under torsion and combined bending and torsion. Design of keys. Design of muff, sleeve, and rigid flange couplings. Design of helical and leaf springs.

Module IV

(7 Hours)

Design of flat belt, V-belt drives and pulleys. Design of gears. Design of screw motion mechanisms like screw jack, lead screw, etc.Selection of anti-friction bearings.

Lecture schedule

1. Meaning of design
2. Phases of design
3. Design consideration
4. Common engineering materials
5. Mechanical properties of engineering materials
6. Types of loads and stresses
7. Theories of failure
8. Factor of safety, selection of allowable stress
9. Stress concentration
10. Elementary fatigue and creep aspects
11. Design of cotter joint
12. Design of knuckle joint
13. Design of pinned joints
14. Design of welded joints subjected to static loads
15. Design of threaded fasteners subjected to direct static loads
16. Design of bolted joints loaded in shear
17. Design of bolted joints subjected to eccentric loading

18. Design of shafts under torsion
19. Design of shafts under bending moment
20. Mid Examination
21. Design of shafts under combined bending and torsion
22. Types of Keys
23. Design of keys
24. Introduction to Couplings
25. Design of sleeve or muff coupling
26. Design of flanged coupling
27. Types of springs
28. Design of helical springs
29. Design of leaf springs
30. Design of flat belt drives
31. Design of V-belt drives
32. Design of flat bely pulleys
33. Design of gears
34. Design of screw jack
35. Design of lead screw
36. Selection of anti-friction bearings

Suggested Readings

- Anonymous. 1984. Design data Hand book. PSG, Coimbatore.
- Jain.R.K. 2013.Machine Design.Khanna Publishers, 2-B Nath Market, NaiSarak, New Delhi.
- K Mahadevan and K Balaveera Reddy. 2013. Design Data Handbook for MechanicalEngineering in SI and Metric Units. CBSpublications, New Delhi.
- Khurmi.R.S and Gupta.J.K. 2014.A Text Book of Machine Design. S. Chand & Company Ltd., New Delhi.
- Maleev and Hartman. 1978. Mechanical Design of Machines. CBS Publications, New Delhi.
- Norton. R.L. 1991.Machine Design. Pearson Education, New Delhi.
- Pandya.N.C and Shah.C.S. 1981.Machinedesign.Charotar Book Stall, Anand.
- Shigley.J.E and C.R. Mischke.Mechanical Engineering Design. 2004. Tata McGraw Hill India Ltd., New Delhi.

Fpme. 2105 Electrical Machines and Power Utilization 3(2+1)

Objective

- To impart basic knowledge in Electrical Machines by understanding the Fundamental Concepts and develop analytical skills, conceptual understanding of basic laws and improve the solving problem skills related electrical Machines and power utilization

Theory

Module I

(9 Hours)

Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, Transformer: principle of working, construction of single phase transformer, EMF equation, phasor diagram, Equivalent circuit, transformer on no load, Transformer under load, leakage reactance, voltage regulation, open circuit and short circuit tests, Transformer losses and efficiency.

Module II (10 Hours)

Operation and performance of DC machine (generator and motor), Construction, EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics, DC motor characteristics, starting of shunt and series motors, speed control methods-field and armature control.

Module III (10 Hours)

Polyphase induction motor: construction and principle of operation, starting and running torques, equivalent circuit, effect of rotor resistance, torque equation, starting and speed control methods, single phase induction motor: double field revolving theory, equivalent circuit, characteristics, phase split, capacitor start and shaded pole motors.

Module IV (7 Hours)

Various methods of three phase power measurement; power factor, disadvantages of low power factor and power factor improvement. Concept and analysis of balanced poly-phase circuits. Series and parallel resonance in RLC Circuits.

Practical

To get familiar with AC and DC Machines and measuring instruments, Polarity test on single-phase two winding transformer, Measurement of Coupling Coefficient of Transformer coil, Open Circuit and Short Circuit tests on single phase two winding transformer, Sumpner's test or back to back test on single phase two winding transformer, Load test on single-phase two winding transformer, Parallel operation of two single phase two winding transformers, Load test on 3 phase squirrel cage induction motor, Separation of losses in 3 phase squirrel cage induction motor, Speed control of 3 phase slip ring induction motor, Load test on single phase induction motor, To study characteristics of DC shunt and series motors, To obtain load characteristics of DC shunt, series and compound generators, To Plot OCC of DC Shunt Generator, Three phase power measurement using 2 wattmeter method, To study power consumed in a three-phase circuit; two lights in series controlled by one switch; two lights in parallel controlled by one switch.

Lecture Schedule

1. Magnetic circuit concepts, MMF, Reluctance, Flux Density, Permeability.
2. Analogy with electrical circuits, laws of magnetic circuits
3. Determination of ampere-turns for series and parallel magnetic circuits.
4. Transformer : Principle of working, construction of single phase transformer
5. Emf equation derivation
6. Phasor diagrams, Ideal transformer, transformer on no load.
7. Transformer under load
8. Transformer losses, Hysteresis and eddy current losses.
9. Efficiency, condition for maximum efficiency and voltage Regulation.
10. Open circuit and short circuit tests on single phase transformer.
11. D.C. Machine (generator and motor): Types and Constructional details.
12. Armature windings, Lap and wave windings-comparison.
13. Principle of operation, generation of induced emf, emf equation derivation.
14. Armature reaction, demagnetizing and cross-magnetizing effect.
15. Ampere turns calculations, compensating windings, additional field ampere turns.
16. Effect of armature reaction on commutation of DC Generator.
17. Commutation of D.C. generator, Methods of improving commutation.
18. Losses in DC generator, power stages, different stage efficiencies.

19. D.C. generator operating characteristics.
20. Mid Term Examination.
21. Determination of OCC, process of voltage build up and condition necessary for voltage build up.
22. D.C. Motor, principle of operation, voltage equation.
23. Production of electromagnetic torque, Power stages and stage efficiencies.
24. Starting of DC motors, 3 point and 4 point starters,
25. Speed control methods- field and armature control.
26. Poly-phase induction motor: Construction and principle of operation.
27. Slip ring and Squirrel cage rotor construction. Slip, frequency of rotor currents, Torque developed.
28. Torque at standstill condition, running torque and effect of rotor resistance.
29. Equivalent circuit of rotor, complete equivalent circuit.
30. Theory of rotating magnetic field, Torque versus Slip Characteristics.
31. Losses and power stages, starting of 3 phase induction motors.
32. Single phase induction motor: principle of operation, double field revolving theory.
33. Characteristics of phase split, capacitor start and shaded pole motors.
34. Various methods of three phase power measurement.
35. Power factor, disadvantages of low power factor. Methods for power factor improvement.
36. Concept and analysis of balanced poly-phase circuits. Series and parallel resonance in RLC Circuits.

Practical Schedule

1. To get familiar with AC and DC Machines and measuring instruments.
2. Polarity test on single-phase two winding transformer.
3. Measurement of Coupling Coefficient of Transformer coil.
4. Open Circuit and Short Circuit tests on single phase two winding transformer.
5. Sumpner's test or back to back test on single phase two winding transformer.
6. Load test on single-phase two winding transformer.
7. Parallel operation of two single phase two winding transformers.
8. Load test on 3 phase squirrel cage induction motor.
9. Separation of losses in 3 phase squirrel cage induction motor.
10. Speed control of 3 phase slip ring induction motor.
11. Load test on single phase induction motor.
12. To study characteristics of DC shunt and series motors
13. To obtain load characteristics of DC shunt generator
14. To obtain load characteristics of DC series generator
15. To Plot OCC of DC Shunt Generator.
16. Three phase power measurement using 2 wattmeter method.
17. To study power consumed in a three-phase circuit; two lights in series controlled by one switch; two lights in parallel controlled by one switch.
18. Practical Examination.

Suggested Readings

- Anwani M L. 1997. Basic Electrical Engineering. Dhanpat Rai & Co. (P) LTD. New Delhi.
- Dr. P. S. Bimbhra. 2004. Electrical Machinery, Khanna Publications, New Delhi.
- Thareja BL & Theraja AK. 2005. A text book of Electrical Technology. Vol. I S. Chand & Company LTD., New Delhi.
- Thareja BL & Theraja AK. 2005. A text book of Electrical Technology. Vol. II S. Chand & Company LTD., New Delhi.

Fpme.2106 AutoCAD Applications 2(0+2)

Objective

- To introduce modern techniques and trends in computer aided design and drafting to students and to equip them in preparing technical drawings in standard CAD software.

Practical

Application of computers for drafting and design. Standard and commercially available packages, hardware and software requirements, input – output devices, graphic file formats. Familiarization of CAD window. Study of different co-ordinate systems, various input methods, drafting settings and preferences. Practice on draw, edit and format commands and methods. Practice on dimensioning and adding text to drawing. Organizing the drawing with layers, line width, colours etc. Creating 2D drawing, dimensioning and plotting the drawing.

Creating orthographic views of simple models from pictorial views. Preparing drawings of standard machine elements. Introduction to 3D modelling and practice on basic 3D commands. Demonstration of CNC machine.

Practical Schedule

1. Introduction to the use computers in drafting and design, hardware and software requirements, input – output devices, graphic file formats.
2. Familiarizing CAD window and working with menus and files.
3. Practice on setting up of drawing – SNAP, GRID, LIMITS, UNITS etc.
4. Practice on drawing basic entities – Line, Circle, Arc, Rectangle, Ellipse etc.
5. Study of OSNAP, input methods and display commands.
6. Study of coordinate systems.
7. Practice on drawing basic entities – Polyline, Polygon, Spline etc.
8. Practice on edit / modify commands – Copy, Move etc.
9. Practice on edit / modify commands– Mirror, Rotate, Scale etc.
10. Practice on PEDIT, Explode etc.
11. Practice on trim, extend, lengthen.
12. Practice on edit / modify commands –Fillet, Chamfer, Array etc.
13. Study on Layers, line width, colour etc.
14. Practice on Hatch, Boundary, Region etc.
15. Practice on dimensioning and adding text to drawing.
16. Creating orthographic views of simple models from pictorial views.
17. Creating orthographic views of simple models from pictorial views.
18. Creating orthographic views of simple models from pictorial views.
19. Creating orthographic views of simple models from pictorial views.
20. Preparing drawings with dimensions of machine elements – nuts, bolts etc.
21. Preparing drawings with dimensions of machine elements – nuts, bolts etc.
22. Preparing drawings with dimensions of machine elements – nuts, bolts etc.
23. Preparing drawing of machine parts with all dimensions and allowances - Foot step bearing and knuckle joint
24. Preparing drawing of machine parts with all dimensions and allowances - Foot step bearing and knuckle joint

25. Preparing drawing of machine parts with all dimensions and allowances - Foot step bearing and knuckle joint
26. Preparing drawing of machine parts with all dimensions and allowances - Foot step bearing and knuckle joint
27. Creating different view ports, setting up of drawing for printout and plotting.
28. Introduction to 3D modelling
29. UCS orientation and options.
30. Practice on 3D commands extrude, revolve.
31. Practice on 3D commands sweep, loft etc.
32. Creating 3D models of simple objects.
33. Creating 3D models of simple objects.
34. Introduction to creating complex 3D models.
35. Demonstration of CNC machine.
36. Practical Examination

Suggested Readings

- Finkelstein, E., and Ambrosius, L. 2014. AutoCAD 2015 and AutoCAD LT 2015. Wiley India Pvt. Ltd, New Delhi.
- Lee, K. 1999. Principles of CAD/CAM/CAE Systems. Prentice-Hall, USA.
- Rao, P.N. 2002. CAD/CAM Principles and Applications. McGraw-Hill Education Pvt. Ltd., New Delhi.
- Sareen Kuldeep and Chandan Deep Grewal. 2010. CAD/CAM Theory and Practice. S.Chand & Company Ltd., New Delhi.
- Varghese, P. I., and John, K.C. 2013. Machine Drawing including AutoCAD, VIP Publishers, Thrissur.

Fpme. 2207 Thermodynamics and Automotive Engines 3(2+1)

Objectives

- To acquaint with the basis of energy transfer (thermodynamics) and its application to farm power and agricultural processing techniques
- To understand the constructional details of IC engines and its working principles, particularly of diesel and petrol engines of tractors and power tillers.

Theory

Module I

(10 Hours)

Thermodynamics –macroscopic and microscopic approach- closed and open system, properties, flow and non-flow processes, cycles, equilibrium, temperature, pressure, gas laws, laws of thermodynamics, internal energy. Application of first law in heating and expansion of gases in non-flow processes. First law applied to steady flow processes. Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, Otto, diesel and dual cycles.

Module II

(8 Hours)

Study of engine components their construction, operating principles and functions. Study of engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines. Study of mechanical, thermal and volumetric efficiencies. Study of Engine valve systems, valve mechanism, Valve timing diagrams.

Module III

(8 Hours)

Study of fuel supply system. Study of fuels, properties of fuels, minimum quantity of air and oxygen required for complete combustion of liquid fuels-calculation of air-fuel ratio. Fuel tests for SI and CI engines. Study of detonation of petrol engine and diesel knock IC engines. Study of a simple carburettor and compensating type carburettors- main functional components, working, air-fuel ratios- Study of fuel injection system of diesel engine – fuel pump and injectors, their types, working principles. Engine governing – need of governors, governor types and governor characteristics.

Module IV

(10 Hours)

Study of lubrication system – need, types, functional components. Study of lubricants – physical properties, additives and their application. Engine cooling system – need, cooling methods and main functional components. Additives in the coolant. Study of ignition system of SI engines- Battery Ignition and Magneto Ignition systems. Study of electrical system including battery, starting motor, battery charging, cut-out, etc. Familiarization with the basics of engine testing.

Practical

Tutorials on thermodynamic air cycles. Tools and measuring instruments-Engine parts and functions, working principles etc. Valve system – study, construction and adjustments; Oil & Fuel – determination of physical properties; Fuel supply system of CI and SI engine; Cooling system, Lubricating system & adjustments; Starting and electrical system; Ignition system; Tractor engine heat balance and engine performance curves; Visit to engine manufacturer/ assembler/ spare parts agency.

Lecture Schedule

1. Thermodynamics – macroscopic and microscopic approach
2. Thermodynamic systems-homogeneous and heterogeneous- boundary- surroundings
3. Thermodynamic properties- intensive and extensive-equilibriums-chemical, mechanical and thermodynamic equilibriums
4. Temperature NTP,STP and pressure –atmospheric and absolute– problems
5. Enthalpy, thermodynamic functions- point and path-flow and non-flow processes
6. Vapour and gas – perfect gas - gas laws – Boyle's and Charl's laws
7. Characteristic and Universal Gas constants- relation between Cp and Cv,R,and J- problems
8. Joule's and Avagadro's law- Laws of thermodynamics- Zeroth law
9. First law of thermodynamics- problem - limitations- Second law- Kelvin Plank and Clausius Statements
10. Heating and expansion of gases in non-flow processes- five methods – Constant pressure, volume, temperature, adiabatic and poly tropic processes- expressions for work done and internal energy – problems
11. Representation of these processes on PV diagrams- problems- contd.
12. Clausius theorem – concept of entropy – representation of the processes on TS diagrams
13. Carnot theorem and Carnot cycle-efficiency derivation-problem- TS diagrams
14. Otto and diesel and dual cycles –efficiency derivations- TS diagrams
15. Otto and diesel and dual cycles –problems - TS diagrams
16. Study of IC engine components their construction- terminologies- mechanical, thermal and volumetric efficiencies -problems
17. Operating principles diesel and petrol engines
18. Comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines
19. Study of engine valve systems types and valve mechanism
20. Mid Term Examinations
21. Valve timing diagram- typical valve timing diagrams of diesel and petrol engines

22. Properties of IC engine fuels, fuel supply system of petrol engine – air-fuel ratios- working of a simple and compensating type carburetors
23. Study diesel fuel supply system- working of fuel pump and fuel injectors
24. Fuel tests – calorific value and viscosity of SI and CI engine fuels - minimum quantity of air and oxygen required for complete combustion of liquid fuels - derivation
25. Study of detonation of petrol engine and diesel knock in diesel engines- remedies.
26. Engine governing –mechanical governor- need of governors and governor characteristics
27. Study of lubrication systems – types and working
28. Study of lubricants – physical properties, SAE grades and API scales- additives and their application
29. Engine cooling system – need and types- air and water cooling methods and main functional components
30. Study of ignition system of SI and CI engines
31. Battery ignition system- components and working- problems and remedies
32. Magneto ignition systems- components and working – problems and remedies
33. Study of electrical system including starting motor, battery charging, cut-out, etc.
34. Tractor engine heat balance - problems
35. Engine performance curves- torque reserve
36. Familiarization with the basics of engine testing

Practical schedule

1. Study of tools and measuring instruments used in Heat Engine Laboratory and steam engine
2. To study the constructional details & working principles of Internal Combustion Engines.
3. To study the constructional details & working principles of 4-stroke petrol Engine.
4. To study the constructional details & working principles of 2- stroke petrol Engine.
5. To determine the calorific value of the given solid fuel or liquid fuel using Oxygen Bomb Calorimeter.
6. To determine the kinematic viscosity and absolute viscosity of the given lubricating oil at different temperatures using Redwood Viscometer.
7. To determine the kinematic viscosity and absolute viscosity of the given lubricating oil at different temperatures using Redwood Viscometer.
8. To determine flash point and fire point of the given lubricating oil using Pensky Marten's apparatus.
9. To study the valve timing
10. To study the fuel system of diesel engine- fuel pump and injectors
11. Study of a carburettor.
12. To study the constructional details & working principles of air cooling systems
13. To study the constructional details & working principles of water cooling systems
14. To study the constructional details & working principles of lubricating system.
15. To study the constructional details & working principles of battery ignition system
16. To study the constructional details & working principles of magneto ignition system
17. Visit to IC engine manufacturing industries
18. Practical Examination

Suggested Readings

- Ballney P. L. 1994. Thermal Engineering. Khanna Publishers, New Delhi.
- Nag P K. 1995. Engineering Thermodynamics. Tata McGraw Hill Publishing Co.Ltd., 4/12 Asaf Ali Raod, New Delhi.

Ganesan, V. 1994. Internal Combustion Engines. Tata McGraw Hill Publishing Co. Ltd. 4/12 Asaf Ali Raod, New Delhi

Khurmi R S. 1992. Engineering Thermodynamics. S Chand and Co. Ltd., Ram Nagar, New Delhi.

Kothandaraman C P Khajuria P R and Arora S C. 1992. A Course in Thermodynamics and Heat Engines. Dhanpat Rai and Sons, 1682 Nai Sarak, New Delhi.

Mathur M L and Mehta F S. 1992. Thermodynamics and Heat Power Engineering. Dhanpat Rai and Sons 1682 Nai Sarak, New Delhi.

Pandya, N.C and Shah, C.S. 1990. Elements of Heat Engines. Charotar Publishing House, Court Road, Anand 388 001.

Fpme.2208 Fundamentals of Renewable Energy Sources 3(2+1)

Objective

- To make the student aware on the various basic aspects of energy use, its environmental impact, different classifications of energy sources and on major renewable energy sources and technologies.

Theory

Module I

(6 Hours)

Introduction to energy- Classification-Energy and environment- Concept of Renewable Energy Sources (RES)-Clean Development Mechanism-Role of renewable energy for mitigation of Global warming, Classification of RES, Energy inputs for agricultural production.

Module II

(15 Hours)

Solar Energy: Fundamentals and basic principles- Solar radiation measurement, Basic Principles of Solar thermal energy conversion, Flat plate and Concentrating collectors, different solar thermal devices, Applications and gadgets- Solar drying, Solar still
Solar Photo voltaic electricity production: Principles of Photo voltaic energy production-p-n junctions, Solar cells, PV Systems- Cell characteristics

Module III

(5 Hours)

Wind Energy: Energy available in wind, General formula, Lift and drag. Basics of Wind energy conversion, Power coefficient- Betz limit-Operational parameters of wind turbines-torque coefficient-tip speed ratio. Types of wind turbine rotors

Module IV

(10 Hours)

Bio-energy: Thermo-chemical energy conversion of biomass – Biomass combustion- Combustion of Biomass and stoves -Biomass gasification, Types of gasifiers. Biochemical energy conversion of biomass: Anaerobic digestion process-types of biogas plants- Basic design aspects of Biogas plants- operational and environmental parameters affecting biogas generation. Liquid bio-fuels. Basic principles for production of alcohol and biodiesel.

Practical

Study of solar cookers, solar water heating system, solar dryer, biogas plants and improved biomass stoves, Estimation of thermal efficiency of biomass stove, solar photovoltaic cell characteristics.

Lecture schedule

1. Introduction to energy- basic thermodynamics- Exergy and Energy
2. Classification of energy sources- concept of renewable energy
3. Energy and environment – Global warming and related hazards

4. Role of renewable energy for mitigation
5. Clean development Mechanism
6. Energy inputs for agricultural production- Equivalent energy coefficients
7. Solar Energy: Fundamentals and basic principles
8. Solar radiation measurement
9. Basic Principles of Solar thermal energy conversion
10. Flat plate and Concentrating collectors
11. Different solar thermal devices: Solar water heater
12. Principles of Solar drying
13. Solar pond, solar still and solar chimney
14. Thermal energy utilization using concentrated collectors
15. Solar cooker
16. Basics principles of Solar Photo voltaic electricity production
17. Photo voltaic energy production using p-n junctions
18. Solar cells
19. PV Systems
20. Mid Term Examination
21. Solar Cell characteristics
22. Wind Energy: Energy available in wind, General formula
23. Principle of operation of wind turbines, Lift and drag.
24. Basics of Wind energy conversion, Power coefficient- Betz limit
25. Operational parameters of wind turbines-torque coefficient- tip speed ratio.
26. Types of wind turbine rotors and their salient features
27. Bio-energy: Thermo-chemical energy conversion of biomass
28. Biomass combustion- Combustion of Biomass and stoves
29. Biomass gasification, Types of gasifiers
30. Biochemical energy conversion of biomass: Anaerobic digestion process
31. Types of biogas plants.
32. Basic design aspects of Biogas plants
33. Operational and environmental parameters affecting biogas generation
34. Liquid bio-fuels and their relevance
35. Basic principles for production of alcohol
36. Vegetable oil as fuel- Biodiesel production and use

Practical Schedule

1. Estimation of energy input in agricultural production
2. Study of carbon foot print estimation
3. Estimation of calorific value of fuels
4. Study of solar water heating system
5. Study of solar cookers
6. Study of different types of solar dryers
7. Solar drying experiment
8. Study of a lab scale floating gas holder type biogas plant
9. Study of a lab scale floating gas holder type biogas plant
10. Design of biogas plant
11. Study of an improved biomass stove
12. Study of a biomass gasifier
13. Study of a biomass gasifier
14. Study of solar photovoltaic cell characteristics

15. Study of solar photovoltaic cell characteristics
16. Estimation of solar energy availability at a locality
17. Visit to renewable energy power production facilities
18. Practical Examination

Suggested Readings

- Chakraverty, A. 1989. Bio-technology and other alternative technologies for utilization of Biomass/Agri. Wastes. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
- Chawla, O.P. 1986. Advances in biogas Technology, IARI, New Delhi.
- FAO 1992. Biogas processes for sustainable development. Food and Agri.Organisation of the U.N. Rome.
- Mathur, A.N. and Rathore N.S. 1992.Biogas production, management and utilization.Himanshu Publication. Delhi.
- Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.
- Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Non Conventional Energy Sources, Himanshu Publications.
- Rathore N. S., Kurchania A. K., Panwar N. L. 2007. Renewable Energy, Theory and Practice, Himanshu Publications.
- Sukhatme, S.P. and Nayak, J.K. 2012. Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi
- Tiwari, G.N. and Ghoshal, M.K. 2005. Renewable Energy Resources: Basic Principles and Applications. Narosa Pub. House. Delhi.

Fpme.3109 Tractor Systems and Controls 3(2+1)

Objectives

- To equip the student with sufficient knowledge about tractor and its various systems, their principles of operation and types, components etc.;
- To impart knowledge on the concept of traction and mechanics of tractor;
- To introduce the ergonomic and safety considerations in tractors; and tractor testing

Theory

Module I

(3 Hours)

Introduction to Tractors - Review of engine parts and their functions- Introduction to transmission system in a tractor – components - functioning

Module II

(17 Hours)

Study of clutch – need, types, functional requirements, construction and principle of operation; Familiarization with single plate, multi-plate, centrifugal and dual clutch systems; Study of Gear Box – gear terminology – types of gears - principle of operation; Gear box types - functional requirements; Calculation for speed ratio; Study of differential system – need, functional components, construction; Calculation for speed reduction; Study of final drive – need, types ; Study of brake system – types, principle of operation, construction; Calculation for braking torque; Study of steering system – requirements, functional components; Steering geometry characteristics Calculation for turning radius; Familiarization with Ackerman steering - Steering systems in track type tractors; Introduction to hydraulic system - principle of operation; Types of hydraulic system, main functional components, functional requirements; Familiarization with the hydraulic system adjustments and ADDC; Introduction to tractor power outlets – PTO, PTO standards, types and functions; Study of power tiller transmission system and clutches – components and functions.

Module III**(14 Hours)**

Introduction to traction - Traction terminology; Theoretical calculation of shear force and rolling resistance on traction device; Study of wheels and tyres – Solid tyres and pneumatic tyres; Tyre construction and tyre specifications; Study of traction aids; Study of tractor mechanics – forces acting on the tractor; Determination of CG of a tractor; Weight transfer in a tractor; Determination and importance of moment of inertia of a tractor; Study of tractor static equilibrium, tractor stability especially at turns; Determination of maximum drawbar pull; Familiarization with tractor as a spring-mass system

Module IV**(2 Hours)**

Ergonomic considerations and operational safety; Introduction to tractor testing - Deciphering the test codes.

Practical

Introduction to transmission systems and components; Study of clutch functioning, parts and design problem on clutch system; Study of different types of gear box, calculation of speed ratios, design problems on gear box; Study on differential and final drive and planetary gears; Study of brake systems and some design problems; Steering geometry and adjustments; Study of hydraulic systems in a tractor, hydraulic trainer and some design problems; Appraisal of various controls in different makes tractors in relation to anthropometric measurements. Determination of location of CG of a tractor, Moment of Inertia of a tractor. Traction performance of a traction wheel.

Lecture Schedule

1. Introduction to Tractors- Line diagram
2. Review of engine parts and their functions
3. Introduction to transmission system in a tractor –components - functioning
4. Study of clutch – need, types, functional requirements, construction and principle of operation
5. Familiarization with single plate, multi-plate, centrifugal and dual clutch systems
6. Study of Gear Box – gear terminology – types of gears - principle of operation
7. Gear box types - functional requirements.
8. Calculation for speed ratio
9. Study of differential system – need, functional components, construction
10. Calculation for speed reduction
11. Study of final drive –need, types
12. Study of brake system – types, principle of operation, construction
13. Calculation for braking torque
14. Study of steering system – requirements, functional components
15. Steering geometry characteristics. Calculation for turning radius
16. Familiarization with Ackerman steering
17. Steering systems in track type tractors
18. Introduction to hydraulic system-principle of operation
19. Types of hydraulic system, main functional components, functional requirements
20. Mid Term Examination
21. Familiarization with the hydraulic system adjustments and ADDC
22. Introduction to tractor power outlets – PTO, PTO standards, types and functions
23. Study of power tiller transmission system and clutches – components and functions
24. Study of power tiller transmission system and clutches – components and functions
25. Introduction to traction - Traction terminology
26. Theoretical calculation of shear force and rolling resistance on traction device
27. Study of wheels and tyres – Solid tyres and pneumatic tyres

28. Tyre construction and tyre specifications
29. Study of traction aids. Study of tractor mechanics – forces acting on the tractor
30. Determination of CG of a tractor. Weight transfer in a tractor.
31. Determination and importance of moment of inertia of a tractor
32. Study of tractor static equilibrium, tractor stability especially at turns
33. Determination of maximum drawbar pull
34. Familiarization with tractor as a spring-mass system
35. Ergonomic considerations and operational safety
36. Introduction to tractor testing - Deciphering the engine test codes

Practical Schedule

1. Introduction to transmission systems and components
2. Study of clutch - functioning, parts
3. Design problem on clutch system
4. Study of different types of gear box
5. Calculation of speed ratios
6. Design problems on gear box
7. Study on differential & study of final drive and planetary gears
8. Study of brake systems
9. Steering geometry and adjustments
10. Study of hydraulic systems in a tractor
11. Traction performance of a tractor wheel
12. Appraisal of various controls in different makes of tractors in relation to anthropometric measurements.
13. Finding C.G of a tractor by weighing technique
14. Finding C.G of a tractor using suspension/balancing techniques
15. Finding moment of inertia of a tractor
16. Problems in weight transfer.
17. Study of power tiller
18. Practical Examination

Suggested Readings

- Jain, S. C., and Rai, C. R. 2013. Farm Tractor Maintenance and Repair. Standard Publishers Distributors, Delhi
- Kirpal Singh. 2013. Automobile Engineering Vol. I. Standard Publishers Distributors, Delhi
- Liljedahl, J. B., Turnquist, P. K., Smith, D. W., and Hokey, M. 2004. Tractors and Their Power Units. CBS Publishers and Distributors Pvt. Ltd, New Delhi
- Relevant BIS Test Codes for Tractors.
- Singh, S., and Verma, S. R. 2009. Farm Machinery Maintenance and Management. Indian Council of Agricultural Research, New Delhi

Fpme. 3110 Farm Machinery and Equipment-I 3(2+1)

Objectives

- To familiarize the students with the relevance of farm machinery and its economic analysis.
- To impart knowledge about the various implements for primary, secondary tillage, seeding and planting, its components, construction, working and force analysis.

Theory

Module I

(10 Hours)

Introduction to farm mechanization – Scope, Merits, Limitations, Status of mechanization in the country and state - History of farm mechanization - Research and developments in farm machinery - Classification of farm machines based on operation, power source, in relation to power unit etc. - Unit operation in crop production and related implements / machines - Power units / sources for farm machinery / implements, hitching systems and controls on farm machinery - Field capacities, field efficiency, different ploughing methods - Calculation of field capacity and field efficiency - Economics of machinery usage, fixed cost, variable cost - Methods for calculating depreciation - Estimation of cost of operation - Break even analysis – small, large and own, hired machine - Economic considerations in selection of farm implements and machinery.

Module II

(12 Hours)

Land reclamation and earth moving equipment - Seed bed preparation operations and its classification - Concepts of deep tillage, rotary tillage and minimum tillage - Introduction to machines / implements used for primary and secondary tillage operations - Mould-board plough, disc plough: Functional components, type, constructional details, accessories and attachments - Chisel plough, sub-soiler: Functional components, type, constructional details, accessories and attachments - Horizontal suction, Vertical Suction of MB plough and Disc geometry of disc plough - Forces acting on tillage implements - Draft measurement of tillage implements and calculation of power requirement for the tillage implements - Study of cultivator - Study of harrows - Study of rotary tillers - Study of leveling and puddling implements.

Module III

(9 Hours)

Introduction to sowing, planting & transplanting equipment - Introduction to seed drills, no-till drills, and strip-till drills - Introduction to planters, bed-planters and other planting equipment - Rice transplanters - Study of types of furrow openers - Study of metering systems in drills and planters - Calibration of seed-drills/ planters and adjustments.

Module IV

(5 Hours)

Introduction to materials used in construction of farm machines - Heat treatment processes and their requirement in farm machines - Properties of materials used for critical and functional components of agricultural machines - Introduction to steels and alloys for agricultural application - Identification of heat treatment processes specially for the agricultural machinery components.

Practical

Familiarization with different farm implements and tools. Study of hitching systems, Problems on machinery management. Study of primary and secondary tillage machinery – construction, operation, adjustments and calculations of power and draft requirements. Study of sowing and planting equipment – construction, types, calculation for calibration and adjustments. Study of transplanters – paddy, vegetable, etc. Identification of materials of construction in agricultural machinery and study of

material properties. Study of heat treatment processes subjected to critical components of agricultural machinery.

Lecture Schedule

1. Introduction to farm mechanization – Scope, Merits, Limitations, Status of mechanization in the country and state
2. History of farm mechanization
3. Research and developments in farm machinery
4. Classification of farm machines based on operation, power source, in relation to power unit etc.
5. Unit operation in crop production and related implements / machines
6. Power units / sources for farm machinery / implements, hitching systems and controls on farm machinery
7. Field capacities, field efficiency, different ploughing methods
8. Economics of machinery usage, fixed cost, variable cost
9. Methods for calculating depreciation
10. Estimation of cost of operation
11. Break even analysis – small, large and own, hired machine
12. Economic considerations in selection of farm implements and machinery
13. Land reclamation and earth moving equipment
14. Seed bed preparation operations and its classification
15. Concepts of deep tillage, rotary tillage and minimum tillage
16. Introduction to machines / implements used for primary and secondary tillage operations
17. Mould-board plough, disc plough: Functional components, type, constructional details, accessories and attachments.
18. Chisel plough, sub-soiler: Functional components, type, constructional details, accessories and attachments
19. Horizontal suction, Vertical Suction of MB plough and Disc geometry of disc plough
20. Mid Term Examinations
21. Forces acting on tillage implements
22. Draft measurement of tillage implements and calculation of power requirement for the tillage implements
23. Study of cultivator and harrows
24. Study of rotary tillers
25. Study of leveling and puddling implements
26. Introduction to sowing, planting & transplanting equipment
27. Introduction to seed drills, no-till drills, and strip-till drills
28. Introduction to planters, bed-planters and other planting equipment - Rice transplanters
29. Study of types of furrow openers
30. Study of metering systems in drills and planters
31. Calibration of seed-drills/ planters and adjustments
32. Introduction to materials used in construction of farm machines
33. Heat treatment processes and their requirement in farm machines
34. Properties of materials used for critical and functional components of agricultural machines
35. Introduction to steels and alloys for agricultural application
36. Identification of heat treatment processes specially for the agricultural machinery components.

Practical Schedule

1. Familiarization with different farm implements and tools
2. Familiarization with different farm implements and tools
3. Study on hitching systems
4. Estimating field capacities, field efficiencies and related problems
5. Calculation of cost of operation of farm implements and machinery
6. Problems on selection of farm machinery – economic considerations
7. Study of MB plough
8. Study of Disc plough
9. Calculations of power and draft requirements
10. Study of secondary tillage implements
11. Measurement of draft
12. Study on seed drill
13. Study on planters
14. Study on transplanters
15. Calibration of seed drill
16. Identification of materials of construction in agricultural machinery and study of material properties
17. Study of heat treatment processes subjected to critical components of agricultural machinery
18. Practical Examination

Suggested Readings

- Jain S. C. and Grace Philip. 2012. Farm Machinery – An Approach. Standard Publishers Distributors., New Delhi
- Kepner, R. A., Bainer, R., and Barger, E. L. 2005. Principles of Farm Machinery. CBS Publishers and Distributors Pvt. Ltd., New Delhi
- Ojha, T. P. and Michael, A. M. 2011. Principles of Agricultural Engineering Vol. I. Jain Brothers, New Delhi
- Sahay, J. 2015. Elements of Agricultural Engineering. Standard Publishers and Distributors, New Delhi
- Yadav, R., and Solanki, H. B. 2009. Numericals and Short Questions in Farm Machinery, Power and Energy in Agriculture. New India Publishing Agency, New Delhi.

Fpme. 3111 Bio-Energy Systems: Design and Applications 2(1+1)

Objectives

- To provide in depth knowledge on basic principles of Bio-energy systems.
- To provide skills in design and operation of major bio-energy systems like, improved biomass stoves, biomass furnaces, biogas plants, biomass gasifiers etc. and related appliances.

Theory

Module I

(5 Hours)

Environmental aspects of bio-energy, assessment of greenhouse gas mitigation potential. Energy and biomass availability in Indian farms – Introduction to Bio energy - Biomass – Photosynthesis - Energetics of photosynthesis - Energy farms, energy plantation- Processing of biomass for energy production- Physical and chemical properties of biomass relevant in energy conversion- proximate and ultimate analysis-HHV and LHV- estimation of calorific value- Briquetting of biomass. Classification of bioenergy processes- Thermo-chemical and Bio-chemical energy conversion processes.

Module II**(5 Hours)**

An overview of anaerobic processes for energy production – Biomethanation process – Biogas plant design, operation, fault checking, maintenance. Biogas appliances, engines - Clean-up of biogas - Developments in anaerobic waste management - Design of commercial biogas plants., Principles of high rate biogas systems- Different types of high rate bio-reactors like UASB, Anaerobic filter, fluidised bed and hybrid bioreactors. Energy production from MSW and landfills.

Module III**(4 Hours)**

Use of vegetable oils as fuel - Bio-diesel - general principles of the technology- production and use. Alcohol for fuel purpose- production processes and technology. Hydrogen as fuel – Hydrogen production by bio-photolysis – Biogas Fuel cells.

Module IV**(4 Hours)**

Combustion, gasification and pyrolysis of biomass - Basic principles. Technology and equipment for biomass combustion- Chemistry of gasification- Different types of gasifiers– Thermal applications of producer gas- Use of producer gas in engines.

Practical

Study of biomass characteristics, Study of anaerobic fermentation systems and systems for application of biogas, Study of gasification for industrial process heat, Study of biodiesel production, biomass densification technique, Use of biofuels for thermal applications and mechanical/electrical power

Lecture schedule

1. Basic concepts of bioenergy and its environmental aspects -Greenhouse gas emission- emission reduction
2. Biomass – Photosynthesis - Energetics of photosynthesis-Energy farms, energy plantation
3. Classification of bioenergy processes- Thermo-chemical and Bio-chemical energy conversion processes.
4. Processing of biomass for energy production- Briquetting of biomass-Physical and chemical properties of biomass relevant in energy conversion-
5. Proximate and ultimate analysis HHV and LHV- BOD and COD
6. An overview of anaerobic processes for energy production – Biomethanation process
7. Operation, Fault checking and maintenance of biogas systems
8. Biogas appliances, engines - Clean-up of biogas
9. Principles of high rate biogas systems like UASB, Anaerobic filter, fluidised bed and hybrid bioreactors.
10. Mid Term examination
11. Energy production from MSW and landfills.
12. Use of vegetable oils as fuel - Bio-diesel production and use
13. Alcohol for fuel purpose- production processes and technology.
14. Hydrogen as fuel – Hydrogen production by bio-photolysis- Biogas Fuel cells
15. Combustion, gasification and pyrolysis of biomass - Basic principles.
16. Biomass Combustion - Equipment for biomass combustion
17. Gasifier technology- Chemistry of gasification- Different types of gasifiers
18. Use of producer gas in engines

Practical schedule

1. Study of biomass characteristics like TS, VS, Proximate analysis and their estimation
2. Study of biomass characteristics like TS, VS, Proximate analysis and their estimation
3. Design of biogas system for a dairy unit
4. Assessment of portable biogas plants
5. Estimation of efficiency of biogas stove
6. Study of biogas engine
7. Study of biogas engine
8. Study of anaerobic waste water treatment systems
9. Study of operation parameters of anaerobic high rate bioreactor
10. Study of operation parameters of anaerobic high rate bioreactor
11. Design of biomass gasifier
12. Study of biomass gasifier system used for energy production
13. Study of biomass gasifier system used for energy production
14. Production procedure for biodiesel
15. Study and operation of a briquetting machine
16. Estimation of BOD of an organic waste water sample
17. Estimation of BOD of an organic waste water sample
18. Practical Examination

Suggested Readings

- FAO 1983. Biomass Energy profiles. Food and Agrl. Organisation of the U.N. Rome.
- FAO 1992. Biogas processes for sustainable development. Food and Agrl. Organisation of the U.N. Rome.
- FAO 1997. Renewable biological systems for alternative sustainable energy production. Food and Agrl. Organisation of the U.N. Rome.
- Chakraverty, A. 1989. Bio-technology and other alternative technologies for utilization of Biomass/Agrl. Wastes. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
- Chawla, O.P. 1986. Advances in biogas Technology, IARI, New Delhi.
- Mathur, A.N. and Rathore N.S. 1992. Biogas production, management and utilization. Himanshu Publication. Delhi.
- Mital, K.M., 1996, Biogas systems; Principles and applications, New Age International (P) ltd. Publishers, New Delhi.
- Rai G.D. 1989. Non-conventional Sources of energy. Khanna Publishers. Delhi.
- Sims, Ralph. 2002. The Brilliance of Bioenergy - In Business and In Practice, James & James (Science Publishers) Ltd., Euston.
- Sims, Ralph. 2002. The Brilliance of Bioenergy - In Business and In Practice, James & James (Science Publishers) Ltd, Euston
- Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.

Fpme.3112 Tractor and Farm Machinery Operation and Maintenance-I 1(0+1)

Objective

- To familiarize the students with agricultural tractors and power tillers, its systems, operation, maintenance and safety precautions.

Practical

Familiarization with different makes and models of agricultural tractors and Power Tillers. Identification of functional systems and controls of tractors. Safety rules and

precautions. Maintenance and trouble shooting. Driving practice of tractor and Power tiller. Familiarization with tools for general and special maintenance.

Practical Schedule

1. Familiarization with different makes and models of agricultural tractors and Power Tillers
2. Identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems.
3. Identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems.
4. Familiarization with controls on a tractor, Safety rules and precautions to be observed while driving a tractor.
5. Study of maintenance points to be checked before starting a tractor.
6. Starting and stopping practice of tractor and Power tiller
7. Driving practice of tractor
8. Driving practice of tractor
9. Driving practice of tractor
10. Mid Term Examination
11. Driving practice of power tiller
12. Driving practice of power tiller
13. Introduction to tractor maintenance – precautionary and break-down maintenance.
14. Tractor starting with low battery charge.
15. Introduction to trouble shooting in tractors.
16. Familiarization with tools for general and special maintenance.
17. Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation.
18. Fuel saving tips. Preparing tractor for storage.

Suggested Readings

- Ghosh, R. K., Swan, S. 1993. Practical Agricultural Engineering. Kolkata NayaPrakosh.
- Jain, S. C., and Rai, C. R. 2013. Farm Tractor Maintenance and Repair. Standard Publishers Distributors., New Delhi.
- Operators Manuals of Tractors.
- Service manuals provided by manufacturers.
- Surendra Singh, Verma, S. R. 2009. Farm Machinery Maintenance and Management. India Council of Agricultural Research, New Delhi.

Fpme.3213 Farm Machinery and Equipment-II 3(2+1)

Objective

- To impart knowledge about machines / implements for plant protection, intercultural operation, harvesting and threshing.

Theory

Module I

(9 Hours)

Introduction to plant protection equipment – sprayers and dusters, Classification of sprayers, Types of nozzles – components and function, Calculations for calibration of sprayers and chemical application rates. Introduction to interculture equipment - Use of weeders – manual and powered. Study of

functional requirements of weeders and main components. Familiarization of fertilizer application equipment.

Module II (9 Hours)

Introduction to harvesting - Principles and types of cutting mechanisms. Study of harvesting operation – harvesting methods, harvesting terminology. Study of mowers – types, constructional details, working and adjustments. Study of shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology, cutting pattern. Study of reapers, binders and windrowers – principle of operation and constructional details. Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay.

Module II (9 Hours)

Introduction to threshing systems – manual and mechanical systems. Types of threshing drums and their applications. Types of threshers- tangential and axial, their constructional details and cleaning systems. Study of factors affecting thresher performance. Study of grain combines, combine terminology, classification of grain combines, study of material flow in combines. Computation of combine losses, study of combine troubles and troubleshooting. Study of chaff cutters and capacity calculations. Study of straw combines – working principle and constructional details.

Module III (9 Hours)

Study of root crop diggers – principle of operation, blade adjustment and approach angle, and calculation of material handled. Study of Cotton harvesting – Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Study of tree climbers - coconut climbers. Study of tools for rubber tapping, tea harvesting. Introduction to vegetables and fruit harvesting equipment and tools. Testing of farm machinery – types of tests, test code and procedure. Ergonomic considerations in designing farm machinery.

Practical

Familiarization with plant protection and interculture equipment. Study of sprayers, types, functional components. Study of dusters, types and functional components. Calculations for chemical application rates. Study of nozzle types and spread pattern using patternator. Familiarization with manual and powered weeding equipment and identification of functional components. Study of fertilizer application equipment including manure spreaders and fertilizer broadcasters. Study of various types of mowers, reaper, reaper binder. Study of functional components of mowers and reapers. Familiarization with threshing systems, cleaning systems in threshers. Calculations of losses in threshers. Familiarization with functional units of Grain combines and their types. Calculations for grain losses in a combine. Study of root crop diggers and familiarization with the functional units and attachments. Familiarization with the working of cotton and maize harvesters. Familiarization with vegetable and fruit harvesters.

Lecture Schedule

1. Introduction to plant protection equipment – sprayers and dusters.
2. Classification of sprayers
3. Types of nozzles – components and function
4. Calculations for calibration of sprayers and chemical application rates
5. Introduction to interculture equipments
6. Study of weeders – manual and powered
7. Study of functional requirements of weeders and main components
8. Familiarization of fertilizer application equipment

9. Introduction to harvesting
10. Mid Term Examination
11. Principles and types of cutting mechanisms
12. Study of harvesting operation – harvesting methods, harvesting terminology
13. Study of mowers – types, constructional details, working and adjustments
14. Study of shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology, cutting pattern
15. Study of reapers, binders and windrowers – principle of operation and constructional details
16. Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay
17. Introduction to threshing systems – manual and mechanical systems
18. Types of threshing drums and their applications
19. Types of threshers- tangential and axial, their constructional details and cleaning systems
20. Types of threshers- tangential and axial, their constructional details and cleaning systems
21. Study of factors affecting thresher performance
22. Study of grain combines, combine terminology
23. classification of grain combines, study of material flow in combines
24. Computation of combine losses
25. study of combine troubles and troubleshooting
26. Study of chaff cutters and capacity calculations
27. Study of straw combines – working principle and constructional details
28. Study of root crop diggers – principle of operation, blade adjustment and approach angle, and calculation of material handled
29. Study of Cotton harvesting – Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components
30. Study of Cotton harvesting – Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components
31. Study of maize harvesting combines
32. Study of tree climbers - coconut climbers
33. Study of tools for rubber tapping, tea harvesting
34. Introduction to vegetables and fruit harvesting equipment and tools
35. Testing of farm machinery – types of tests, test code and procedure.
36. Ergonomic considerations in designing farm machinery.

Practical Schedule

1. Study of sprayers, types, functional components.
2. Study of nozzle types and spray pattern using patternator.
3. Calibration of sprayers.
4. Study of dusters, types and functional components
5. Familiarization with manual and powered weeding equipments and identification of its functional components.
6. Study of fertilizer application equipments including manure spreaders and fertilizer broadcasters.
7. Study of fertilizer application equipments including manure spreaders and fertilizer broadcasters.
8. Study of various types of mowers, reaper, reaper binder.
9. Study of cutter bar mechanism of reapers and mowers.
10. Harvesting with reapers.
11. Familiarization with threshing systems and cleaning systems in threshers.

12. Practical of paddy threshing.
13. Calculations of losses, efficiencies in threshers.
14. Familiarization with functional units of Grain combines and their types.
15. Calculations for grain losses in a combine.
16. Familiarization with coconut climbing devices.
17. Familiarization with vegetable and fruit harvesters.
18. Practical Examination

Suggested Readings

- Jain S. C., and Grace Philip. 2012. Farm Machinery – An Approach. Standard Publishers Distributors., New Delhi
- Kepner, R. A., Bainer, R., and Barger, E. L. 2005. Principles of Farm Machinery. CBS Publishers and Distributors Pvt. Ltd., New Delhi
- Ojha, T. P. and Michael, A. M. 2011. Principles of Agricultural Engineering Vol. I. Jain Brothers, New Delhi
- Sahay, J. 2015. Elements of Agricultural Engineering. Standard Publishers and Distributors, New Delhi
- Yadav, R., and Solanki, H. B. 2009. Numericals and Short Questions in Farm Machinery, Power and Energy in Agriculture. New India Publishing Agency, New Delhi.

Fpme. 3214 Tractor and Farm Machinery Operation and Maintenance-II 1(0+1)

Objective

- To familiarize the students with agricultural tractors and power tillers, its systems, operation, maintenance and safety precautions.

Practical

Familiarization with different makes and models of agricultural tractors and Power Tillers. Identification of functional systems and controls of tractors. Safety rules and precautions. Maintenance and trouble shooting. Driving practice of tractor and Power tiller. Familiarization with tools for general and special maintenance.

Practical Schedule

1. Hitching & De-hitching of mounted type implement.
2. Hitching & De-hitching of trailed type implement.
3. Study of field patterns while operating a tillage implement.
4. Practice of operating tillage tool (mould-board plough/ disc plough) and their adjustment in the field.
5. Practice of operating tillage tool (mould-board plough/ disc plough) and their adjustment in the field.
6. Driving practice with a trail type trolley – forward and in reverse direction.
7. Driving practice with a trail type trolley – forward and in reverse direction.
8. Driving practice with a trail type trolley – forward and in reverse direction.
9. Care and maintenance procedure of agricultural machinery during operation and off-season.
10. Repair and maintenance of implements – adjustment of functional parameters in tillage implements.
11. Repair and maintenance of implements – adjustment of functional parameters in tillage implements.
12. Replacement of broken components in tillage implements.

13. Replacement of furrow openers and change of blades of rotavators.
14. Maintenance of cutter bar in a reaper.
15. Adjustments in a thresher for different crops.
16. Replacement of V-belts on implements.
17. Setting of agricultural machinery workshop.
18. Practical Examination.

Suggested Readings

- Ghosh, R. K., Swan, S. 1993. Practical Agricultural Engineering. Kolkata NayaPrakosh.
- Jain, S. C., and Rai, C. R. 2013. Farm Tractor Maintenance and Repair. Standard Publishers Distributors., New Delhi.
- Operators Manuals of Tractors.
- Service manuals provided by manufacturers.
- Surendra Singh, Verma, S. R. 2009. Farm Machinery Maintenance and Management. India Council of Agricultural Research, New Delhi.

Fpme. 3215 Energy Technology for Renewable Power production 2(2+0)

Objectives

- To make the student competent to deal with fundamental issues related to power production from renewable resources.
- To enable him with technical knowhow on the state of the art technology for nourishing his future capabilities in energy sector.

Theory

Module I

(8 Hours)

Energy consumption pattern & energy resources in India. Renewable energy options, potential and present status. Basic principles of fuels- solid, liquid and gaseous fuels- principles of combustion- Design considerations for combustion equipment- stoichiometric air requirement- oil burners and gas burners.

Module II

(8 Hours)

Principles of operation of a steam power plant, Basics of different types of steam turbines- impulse and reaction turbines, Basics of nuclear energy, basic components of a nuclear power reactor, Hydro-electric power generation- basic principles-classification based on hydraulic characteristics and head - Mini and micro hydel plants.

Module III

(8 Hours)

Tidal power- components-operation methods, Principles of OTEC system, wave energy systems, utilization of geo-thermal resources for power production, Fuel cells and hydrogen energy, Magneto hydro dynamic (MHD) power generation- Open cycle and closed cycle MHD. Fuel cell power plants. Estimation of solar energy, Solar thermal and photovoltaic Systems for power generation. Central receiver type solar power plant.

Module IV

(8 Hours)

Wind farms. Estimation of wind energy, Velocity- duration curve, Power – duration curve, frequency – duration curve, Aero-generators, Wind power generation systems. Biogas technology for power

production, Power generation from urban, municipal and industrial waste, Energy from landfills- Combustion of biomass- Basic principles for design of combustion equipment.

Lecture schedule

1. Energy consumption pattern & energy resources in India.
2. Renewable energy options, potential and present status.
3. Basic principles of fuels- solid, liquid and gaseous fuels,
4. Principles of combustion
5. Design considerations for combustion equipment
6. Stoichiometric air requirement
7. Estimation of flue gas quantity
8. Oil burners and Gas burners
9. Principles of operation of a steam power plant
10. Mid Term Examination
11. Different types of steam turbines- impulse and reaction turbines
12. Nuclear energy, basic components of a nuclear power reactor
13. Hydro-electric power generation
14. Classification based on hydraulic characteristics and head
15. Mini and micro hydel plants – Characteristics
16. Tidal power- principles
17. Components and operation of tidal power systems
18. Principles of OTEC system
19. Wave energy systems
20. Geo-thermal resources for power production
21. Hydrogen energy
22. Fuel cell Technology
23. Fuel cell power plants
24. Magneto hydro dynamic (MHD) power generation
25. Open cycle and closed cycle MHD
26. Photovoltaic Systems for power generation
27. Estimation of solar energy
28. Solar thermal Systems for power generation
29. Central receiver type solar power plant
30. Wind farms- Estimation of wind energy- Important field parameters
31. Velocity- duration curve, Power – duration curve, Frequency –duration curve
32. Aero-generators, Wind power generation systems.
33. Biogas technology for power production
34. Power generation from urban, municipal and industrial waste
35. Energy from land fills
36. Combustion of biomass- Principles for design of combustion equipment.

Suggested Readings

- Bansal N.K., Kleemann M. and Meliss Michael. 1990. Renewable Energy Sources & Conversion Technology; Tata Mecgrow Publishing Company, New Delhi.
- Garg H.P. 1990. Advances in Solar Energy Technology; D. Publishing Company, Tokyo.
- Rai, G.D.,2010. An introduction to Power Plant Technology, Khanna Publishers, Delhi
- Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.
- Rao, S. and Parulekar B.B. 2005. Energy Technology, Khanna Publishers, Delhi

- Rathore N. S., Kurchania A. K. & N.L. Panwar. 2007. Non-Conventional Energy Sources, Himanshu Publications.
- Sims, Ralph. 2002. The Brilliance of Bioenergy - In Business and In Practice, James & James (Science Publishers) Ltd., Euston.
- Sukhatme, S.P. and Nayak, J.K. 2012. Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi

Fpme. 3216 Ergonomics in Farm Machinery 1(1+0)

Objectives

- To impart basic knowledge in Ergonomics by understanding the Fundamental Concepts
- To acquaint and equip with the ergonomic aspects in the design of farm machinery for more output and safety of human beings.

Theory

Module I (8 Hours)

Importance of ergonomics and its application in agriculture; Energy liberation in human body; Assessment of energy expenditure- direct calorimetry, Indirect calorimetry- Assessment by oxygen consumption; Techniques of measuring oxygen consumption; Assessment by heart rate and calibration; Assessment by subjective rating of perceived effort- Overall discomfort score and BPDS; Basal metabolism and work metabolism; Assessment of work load; Assessment of Individual's maximal work capacity.

Module II (5 Hours)

Anthropometry; Anthropometric data and measurement techniques; Anthropometric dimensions and strength parameters; Causes of variability of anthropometric data; Analysis of anthropometric data and use of percentiles

Module III (3 Hours)

Biomechanics of motion. Vibration- hand arm vibration and whole body vibration, physiological effects; Noise and its physiological effects.

Lecture schedule

1. Importance of ergonomics and its application in agriculture
2. Energy liberation in human body
3. Assessment of energy expenditure- direct calorimetry, Indirect calorimetry
4. Assessment by oxygen consumption; Techniques of measuring oxygen consumption
5. Assessment by heart rate and calibration
6. Assessment by subjective rating of perceived effort- Overall discomfort score and BPDS
7. Assessment by subjective rating of perceived effort- Overall discomfort score and BPDS
8. Basal metabolism and work metabolism
9. Assessment of work load; Assessment of Individual's maximal work capacity
10. Introduction to Anthropometry
11. Anthropometric data and measurement techniques
12. Anthropometric dimensions and strength parameters
13. Causes of variability of anthropometric data
14. Analysis of anthropometric data and use of percentiles
15. Introduction to Biomechanics of motion

16. Vibration- hand arm vibration and whole body vibration, physiological effects
17. Noise and its physiological effects.
18. Practical Examination

Suggested Readings

- Astrand, P.O and Rodahl, K.1977. Text book of work physiology, McGraw Hill, New York
- Bridger, R.S,1995. Introduction to Ergonomics, McGraw Hill, New York
- Dul J and Weerdmeester B.1993.Ergonomics for Beginners. A Quick Reference Guide. Taylor and Francis, London.
- Kroemer, K.H.E., Kroemer,H.J. and K.E.Kroemer-Elbert. 1997. Engineering Physiology: bases of human factors/ergonomics, VAN NOSTRAND REINHOLD, New York.
- Rodal, K.1989.The Physiology of work, Taylor and Francis, London.

Department of Farm Power Machinery and Energy-Electives

Elfm.4201 Mechanics of Tillage and Traction 3(2+1)

Objective:

To impart basic knowledge in mechanics of tillage and traction by understanding the fundamental concepts and to develop analytical and practical skills in farm machinery.

Module I (9 Hours)

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship.

Module II (9 Hours)

Design of tillage tools principles of soil cutting, design equation, force analysis.

Module III (9 Hours)

Application of dimensional analysis in soil dynamics and traction prediction equation.

Module IV (9 Hours)

Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, tyre size, tyre lug geometry and their effects, tyre testing. Soil compaction and plant growth, variability and application of GIS in soil dynamics.

Practical

Measurement of static and dynamic soil parameters related to tillage, soil parameters related to puddling and floatation, draft for passive rotary and oscillating tools, slip and sinkage under dry and wet soil conditions and load and fuel consumption for different farm operations; Weight transfer and tractor loading including placement and traction aids; Studies on tyres, tracks and treads under different conditions, and soil compaction and number of operations.

Lecture schedule

1. Study of tillage operations- forces acting on a tillage implement- draft
2. Physical properties of soils
3. Engineering properties of soil- consistency limits – shear strength
4. Mohr's circle – shear failure- Coulomb's equation- general model of shear failure
5. Mohr's circle – shear failure- Coulomb's equation- general model of shear failure
6. Tri-axial compression test- stress strain theory- relationship
7. Force analysis of tillage implements
8. Dimensional Analysis- units and dimensions - definition- systems of measurements
9. Dimensional Analysis- Dimension of entities- Dimensionless numbers
10. Complete set of dimensionless products
11. Methods of determining dimensionless products- Rayleigh's method
12. Buckingham Pi theorem and method –problems
13. Systematic analysis methods of DA-problems
14. Development of prediction equation through dimensional analysis
15. Mechanics of tillage tools-tractive performance of wheeled vehicles- off road traction mechanics- objectives
16. Rolling resistance at different soil and tyre conditions
17. Prediction of sinkage- Bekker's and Columb's equations – plate test
18. Mobility number- Wheel numeric

19. Weismer and Luth Equation- Analysis of soil-machine dynamics in tillage
20. Mid Term Examination
21. Relation between tractive force and slip.
22. Mechanical properties of soils- strength determining factors and floatation
23. Penetration resistance and mobility number approach for predicting field performance of tyres
24. Typical values of cone penetrometer resistances
25. Traction - tractive efficiency and coefficient of traction at varying slips
26. Draw bar power – its variation w.r.to various pull and slip conditions
27. Design of tillage tools- active and passive tools
28. Application of dimensional analysis in soil dynamics
29. Traction mechanics
30. Traction models
31. Traction improvement methods
32. Cone index and its determination
33. Tyres for agricultural tractors
34. Tyre and track terminology and selection of tyres
35. Soil compaction studies – compaction measurement
36. Application of GIS in soil dynamics

Practical Schedule

1. Measurement of static and dynamic soil parameters related to tillage
2. Measurement of Soil parameters related to puddling and floatation
3. Draft measurement of tractor attached implements
4. Draft measurement for passive tools
5. Draft measurement for active tools
6. Measurement of Slip
7. Measurement sinkage under wet soil conditions
8. Load and fuel consumption tests for tractor engines.
9. Load and fuel consumption tests for tractor engines.
10. Study of weight transfer of a tractor
11. Study of tractor tyres and traction aids
12. Visibility test for tractors
13. Measurement of puddling index of wet soils
14. Measurement of turbidity index
15. Study of different methods of ballasting
16. Determination of cone index
17. Visit to R&D organizations dealing with tillage studies
18. Practical Examination

Suggested Readings

- Bosoi, E.S, Verniaev, O.V., Smirnov, I.I and Sultan Shakh. 1990. Theory, Construction and Calculations of Agricultural Machines. Vol. I. Oxonian press Pvt. Ltd., New Delhi.
- Daniel Hillel. 1980 Fundamentals of Soil Physics. Academic Press, Inc. Ltd. New York
- Gill William, R. and Glen E. Vanden Berg. 1968. Soil Dynamics in Tillage and Traction. Scientific Publishers (India), Reprint 2013.
- Kuipers, H and Koolen, A.J. 1983. Agricultural Soil Mechanics. Springer-Verlag New York
- Kumar, V.J.F and Durairaj, C.D. 2003. Dimensional Analysis and Similitude (Through worked examples). New Age International Pvt. Ltd., New Delhi. (ISBN-8122414868).

Langhaar, H.L.1951. Dimensional Analysis and Theory of Models. Robert E. Krieger Publishing Company, Malabar, Florida.
Liljedahl, J. B., Turnquist, P. K., Smith, D. W. and Hoki, M. 2004.Tractors and their Power Units. CBS Publishers Pvt. Ltd.
Mehta, M.L, Verma,S.R., Misra, S.K and Sharma, V.K. 1995. Testing and evaluation of Agricultural Machinery. National Agricultural Technology Information Centre.89,I Block Sarabha Nagar, Ludhiana 141 001

Elfm.4202 Farm Machinery Design and Production 3(2+1)

Objective

To impart basic knowledge in Farm Machinery Design and Production by understanding the Fundamental Concepts and develop analytical and practical skills in that field.

Module I (9 Hours)

Introduction to design parameters of agricultural machines & design procedure. Characteristics of farm machinery design. Research and development aspects of farm machinery.

Module II (9 Hours)

Design of standard power transmission components used in agricultural machines: mechanical & hydraulic units. Introduction to safety in power transmission. Application of design principles to the systems of selected farm machines.

Module III (9 Hours)

Critical appraisal in production of Agricultural Machinery; Advances in material used for agricultural machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques including powder metallurgy, EDM (Electro-Discharge Machining).

Module IV (9 Hours)

Heat Treatment of steels including pack carburizing, shot pining process, etc. Limits, Fits & Tolerances, Jigs & Fixtures. Industrial lay-out planning. Quality production management. Reliability. Economics of process selection. Familiarization with Project Report.

Practical

Familiarization with different design aspects of farm machinery and selected components. Solving design problems on farm machines & equipment Visit to Agricultural machinery manufacturing industry, Tractor manufacturing industry Jigs and Fixtures – study in relation to agricultural machinery. Fits, tolerances and limits; Layout planning of a small scale industry; Problems on Economics of process selection; Preparation of a project report; Case study for manufacturing of simple agricultural machinery.

Lecture schedule

1. Introduction to design parameters of agricultural machines
2. Introduction to design procedure of agricultural machines
3. Characteristics of farm machinery design.
4. Research and development aspects of farm machinery.
5. Introduction to standard power transmission components
6. Design of power transmission components used in agricultural machines
7. Components of Power Transmission - mechanical
8. Components of Power Transmission - hydraulic
9. Introduction to safety in power transmission

10. Application of design principles to the systems of selected farm machines
11. Application of design principles to the systems of selected farm machines
12. Application of design principles to the systems of selected farm machines
13. Critical appraisal in production of Agricultural Machinery
14. Advances in material used for agricultural machinery.
15. Cutting tools including CNC tools and finishing tools.
16. Cutting tools including CNC tools and finishing tools.
17. Advanced manufacturing techniques
18. Powder metallurgy
19. EDM (Electro-Discharge Machining)
20. Mid-term examination
21. Heat Treatment of steels including
22. Pack carburizing
23. Shot pining process
24. Limits, Fits & Tolerances
25. Jigs & Fixtures.
26. Industrial lay-out planning
27. Industrial lay-out planning
28. Industrial lay-out planning
29. Industrial lay-out planning
30. Quality production management
31. Reliability.
32. Economics of process selection.
33. Familiarization with Project Report.
34. Familiarization with Project Report.
35. Familiarization with Project Report.
36. Familiarization with Project Report.

Practical Schedule

1. Familiarization with different design aspects of farm machinery and selected components
2. Solving design problems on farm machines & equipment
3. Visit to Agricultural machinery manufacturing industry
4. Visit to Agricultural machinery manufacturing industry
5. Visit to Tractor manufacturing industry
6. Visit to Tractor manufacturing industry
7. Jigs and Fixtures – study in relation to agricultural machinery
8. Jigs and Fixtures – study in relation to agricultural machinery
9. Jigs and Fixtures – study in relation to agricultural machinery
10. Fits, tolerances and limits
11. Fits, tolerances and limits
12. Layout planning of a small scale industry
13. Layout planning of a small scale industry
14. Problems on Economics of process selection
15. Problems on Economics of process selection
16. Preparation of a project report
17. Case study for manufacturing of simple agricultural machinery.
18. Practical examination

Suggested Readings

- Khurmi, R. S. and Gupta, J. K. 2012. Text Book of Machine Design. S Chand Publications.
- Sharma, D. N. and Mukesh, 2010. S., Farm Machinery Design. 2nd edition. LP, New Delhi.
- Sharma, D. N. and Mukesh, S. 2012. Design of Agricultural Tractor. 2nd edition. LP, New Delhi.

Elfm.4203 Human Engineering and Safety 3(2+1)

Objective

To impart basic knowledge in Human Engineering by understanding the Fundamental Concepts and to acquaint and equip with the human factors in the design of farm machinery and tractors for safety of human beings.

Theory

Module I (9 Hours)

Human factors in system development – concept of systems; basic processes in system development; performance reliability, human performance; Metabolic system, human energy machine, Human metabolism and work; Energy liberation in human body; Energy for muscle work; Assessment of energy expenditure- direct calorimetry, Indirect calorimetry; Techniques of measuring oxygen consumption; Assessment of work load; Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications.

Module II (9 Hours)

Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems. Human motor activities, controls, tools and related devices. Analysis of arm lifting, Types of body joints, Mobility- Maximal displacement of body joints.

Module III (9 Hours)

Introduction to Anthropometry; Equipments for measuring anthropometric data; Identification of anthropometric dimensions and strength parameters for the design of Agro Machinery and equipment; arrangement and utilization of work space; Use of anthropometric dimensions for the functional components of farm Machinery and equipment; functional Anthropometry; causes of variability of anthropometric data-; Inter-individual variations, Intra-individual variations, Secular changes, Poor data; Designing to fit the body; Normality, variability, correlations and use of percentiles

Module IV (9 Hours)

Fundamentals of human thermoregulation, thermal balance, measuring the thermal environment- dry bulb temperature, relative humidity and wet bulb temperature, globe temperature, air movement and wind chill; heat stress ;Work in hot climates- heat stroke, relative humidity, heat acclimatization; personal factors affecting heat tolerance, Heat stress management; work in cold climates- core temperature, acclimatization to cold, perception to cold, Skin temperature; Air pollution. Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

Practical schedule

Calibration of the subject in the laboratory using bi-cycle ergo-meter. Study and calibration of the subject in the laboratory using mechanical treadmill; Use of respiration gas meter from human energy point of view. Use of Heart Rate Monitor. Study of general fatigue of the subject using Blink ratio method, Familiarization with electro-myograph equipment, anthropometric measurements of a selected subjects. Optimum work space layout and locations of controls for different tractors. Familiarization with the noise and vibration equipment. Familiarization with safety gadgets for various farm machines.

Lecture schedule

1. Introduction to human factors in system development, concept of systems, basic processes in system development
2. Performance reliability and human performance
3. Metabolic system; human energy machine
4. Human metabolism and work; Energy liberation in human body; Energy for muscle work
5. Assessment of energy expenditure- direct calorimetry, Indirect calorimetry
6. Techniques of measuring oxygen consumption
7. Assessment of work load
8. Introduction to visual displays, Major types and use of displays
9. Auditory and factual displays
10. Speech communications
11. Introduction to Biomechanics of motion
12. Stress and strain, Newton's laws
13. Types of movements. Range of movements
14. Strength and endurance, speed and accuracy
15. Human control of systems
16. Human motor activities, tools and related devices
17. Analysis of arm lifting. Types of body joints
18. Mobility- Maximal displacement of body joints
19. Introduction to Anthropometry
20. Mid-term examination
21. Equipment's for measuring anthropometric data
22. Identification of anthropometric dimensions and strength parameters for the design of Agro Machinery and equipment
23. Use of anthropometric dimensions for the functional components of farm Machinery and equipment, arrangement and utilization of work space
24. Functional Anthropometry
25. Causes of variability of anthropometric data-Inter-individual variations, Intra-individual variations, Secular changes, Poor data. Designing to fit the body
26. Normality, variability, correlations and use of percentiles
27. Fundamentals of human thermoregulation, thermal balance
28. Measuring the thermal environment- dry bulb temperature, relative humidity and wet bulb temperature, globe temperature,
29. Air movement and wind chill, Heat stress
30. Work in hot climates- heat stroke, relative humidity, heat acclimatization
31. Personal factors affecting heat tolerance, Heat stress management
32. Work in cold climates- core temperature, acclimatization to cold, perception to cold,
33. Skin temperature; Air pollution.
34. Dangerous machine (Regulation) act , Rehabilitation and compensation to accident victims

35. Safety gadgets for spraying, threshing, Chaff cutting
36. Safety gadgets for tractor & trailer operation etc.

Practical schedule

1. Measurement of Basal Metabolic Rate of subjects
2. Calibration of the subject in the laboratory using bi-cycle ergo-meter
3. Calibration of the subject in the laboratory using mechanical treadmill
4. Use of respiration gas meter
5. Use of Heart Rate Monitor
6. Measurement of heart rate of subjects while using sprayers
7. Measurement of heart rate of subjects while using sprayers
8. Measurement of heart rate of subjects while using weeders
9. Measurement of heart rate of subjects while using weeders
10. Measurement of heart rate of subjects while using weeders
11. Study of general fatigue of the subject using Blink ratio method
12. Familiarization with electro-myograph equipment
13. Anthropometric measurements of selected subjects
14. Measurement of strength parameters of selected subjects
15. Optimum work space layout and locations of controls for different tractors
16. Familiarization with the noise and vibration equipment
17. Familiarization with safety gadgets for various farm machines
18. Practical examination

Suggested Readings

- Astrand P. And and Rodahl K. 1977. Textbook of Work Physiology. Mc Hill Corporation, New York.
- Chapanis A. 1996. Human Factors in System Engineering. John Wiley & Sons, New York.
- Dul J. and Weerdmeester B. 1993. Ergonomics for Beginners. A Quick Reference Guide. Taylor and Francis, London.
- Keegan J J, Radke AO. 1964. Designing vehicle seats for greater comfort. SAE Journal; 72:50~5.
- Mark S. Sanders and Ernest James McCormick. 1993. Human Factors in Engineering and Design. Mc Hill Corporation, New York.
- Mathews J. and Knight A. A. 1971. Ergonomics in Agricultural Equipment Design. National Institute of Agricultural Engineering.
- Yadav R, Tewari V.K. 1998. Tractor operator workplace design-a review. Journal of Terra mechanics 35: 41-53.

Elfm. 4204 Tractor Design and Testing 3(2+1)

Objectives

- To impart knowledge about the mechanics of traction of tractors and the factors affecting traction including different traction aids.
- To familiarize the students with the relevance and basics of design of an agricultural tractor and its components such as engine, transmission system, fuel system, lubrication system, cooling system, hydraulic system and controls and the ergonomics in tractor design.
- To impart knowledge in the problem solving skills related to tractor stability.

- To impart basic knowledge in testing and evaluation of tractor.

Theory

Module I (14 Hours)

Introduction to procedure for design and development of agricultural tractors. Traction theory- Traction mechanism. mechanics of traction devices. Kinematics and dynamic aspects of Rolling elements. Tire selection. Traction devices for wet lands. Mechanics of traction-Traction performance. Tread design- traction improvements. Mechanics of tractor chassis – Static equilibrium analysis. Centre of gravity & moment of inertia.

Module II (9 Hours)

Tractor Engine - Parameters affecting design of tractor engine-General design considerations. Design of engine components. Design of fuel injection system, lubrication system, cooling system and ignition system. Design of mechanical power transmission in agricultural tractors. Friction brakes and clutches. Design of Ackerman Steering and tractor hydraulic steering. Mechanics of steering & front suspension.

Module III (5 Hours)

Hydraulic systems & controls – basic principles, components and symbols. Flow and circuit analysis, motors, actuators, valves, hydraulic fluids and controls. Draft sensing, automatic control, power steering. Hydraulic circuit design. Hitches, hitching and weight transfer. Force and moment relations for a tractor when pulling an implement, control of hitches.

Module IV (8 Hours)

Human factors in tractor design - environmental factors, noise, vibration. Operator – machine interface, Design aspects of foot and hand controls, rollover protection, thermal comfort and safety. Operator's seat. Pollution control technologies. Tractor Testing: Types, test procedure, national and international codes. Types of tests. Tractor performance criteria- Power measurement methods – types of dynamometers. Drawbar, PTO and three point hitch performances. Power losses in dynamometers and hydraulic test equipment. Review and interpretation of test reports. Case studies.

Practical

Design problem of tractor clutch – (Single/ Multiple disc clutch). Design of gear box(synchromesh/constant mesh), variable speed constant mesh drive; Selection of tractor tires – Problem solving. Problem on design of governor. Design and selection of hydraulic pump. Engine testing as per BIS code. Drawbar performance in the lab; PTO test and measure the tractor power in the lab/field; Determining the turning space, turning radius and brake test, hydraulic pump performance test and air cleaner and noise measurement test; Visit to tractor testing centre/industry.

Lecture schedule

1. Introduction to procedure for design and development of agricultural tractors. Technical specifications of tractors available in India.
2. Modern trends in tractor design and development.
3. Special design features of tractors in relation to Indian agriculture.
4. Introduction to CAD and its application in agricultural tractors.
5. Traction theory: Co-efficient of traction

6. Deflection between traction devices and soil, slippage and sinkage of wheels.
7. Evaluation and prediction of traction performance, design of traction and transport devices.
8. Traction mechanism: Introduction of traction devices. Tires-types function & size, their selection.
9. Mechanics of traction devices. Off road traction mechanics, Trafficability.
10. Performance evaluation, design considerations traction devices.
11. Kinematics and dynamic aspects of rolling elements.
12. Tire selection. Traction devices for wet lands- Tracks, cage wheels, cage rollers.
13. Mechanics of traction: Traction performance equation, performance of tires, tire size, load & air pressure relationship.
14. Tread design- effect of lug spacing, traction improvements.
15. Mechanics of tractor chassis – assumptions, equations of motion. Static equilibrium analysis, longitudinal stability, Lateral stability.
16. Determination of Centre of gravity & moment of inertia. Problems
17. Tractor Engine - Parameters affecting design of tractor engine and their selection, General considerations in engine design.
18. Design of engines - Stroke-bore ratio, crankshaft & firing order, valve design, valve timing, cam shaft.
19. Combustion chamber design, piston, flywheels, balancing of engines.
20. Mid-term examination
21. Design of fuel injection system, lubrication system, cooling system and ignition system.
22. Design of mechanical power transmission in agricultural tractors: Tractor transmission and drive chains – complete drive train, transmission types, gears for power transmission.
23. Differentials, transmission drive shafts. Friction brakes and clutches- single disc, multi disc and cone clutches. Rolling friction and anti-friction bearings.
24. Design of Ackerman Steering and tractor hydraulic steering.
25. Mechanics of steering & front suspension of farm tractor.
26. Hydraulic systems & controls – basic principles of hydraulics, components and symbols.
27. Basics of hydraulic flow and hydraulic circuit analysis motor performance, actuators, valves, hydraulic fluids and controls.
28. Draft sensing, automatic control, power steering. Hydraulic circuit design.
29. Hitches – types, principles, hitching and weight transfer, force and moment relations for a tractor when pulling an implement, control of hitches.
30. Human factors in tractor design – operator exposure to environmental factors, noise, and vibration. Operator – machine interface.
31. Design aspects of foot and hand controls on tractors, rollover protection, thermal comfort and safety.
32. Design of operator's seat for tractors and agricultural equipment. Pollution control technologies.
33. Tractor Testing: Types of tests; test procedure, national and international codes.
34. Test equipment- usage and limitations. Types of tests – compulsory tests, optional tests, static & dynamic tests, noise test.
35. Tractor performance criteria – Power measurement methods – types of dynamometers. Drawbar, PTO and three point hitch performances.
36. Power losses in dynamometers and hydraulic test equipment. Review and interpretation of test reports. Case studies.

Practical schedule

1. Determination of Slip, Rolling resistance and pull of a tractor.
2. Determination of Centre of gravity of Tractor.
3. Determination of Co-efficient of Rolling resistance, Co-efficient of Traction and Tractive efficiency.
4. Measurement of diametric parameters of tyres.
5. Determination of turning space and turning radius.
6. Problems on Mechanics of Traction.
7. Measurement of Tractive parameter by two tractor method.
8. Design problem of tractor engine. Design problem of tractor clutch.
9. Design problem of tractor gear box.
10. Design problem of Fuel injection pump for tractor engine.
11. Design problem of Lubrication system of Tractor
12. Design problem of cooling system of Tractor.
13. Selection of tractor tires – Problem solving.
14. Design and selection of hydraulic pump.
15. Engine testing as per BIS code.
16. Drawbar and PTO performance in the lab/field.
17. Visit to tractor testing centre/industry.
18. Practical examination

Suggested Readings

- Liljedahl J B, Turnquist P K, Smith D W, and Hoki M.(1996), Tractors and Their Power Units, CBS Publishers & Distributors.
- Mehta ML, SR Verma, SK Mishra, VK Sharma.(2010), Testing & Evaluation of Agricultural Machinery.
- Pandey, M M & Others.(2013), Handbook of Agricultural Engineering, Indian Council of Agricultural Engineering, New Delhi.
- Raymond N Y, Ezzat A F and Nicolas Skiadas.(1984), Vehicle Traction Mechanics, Elsevier Science Publishers B V, New York.
- Sharma, D N and Mukesh, S.(2010), Design of Agricultural Tractor- Principles and problems, Jain brothers, New Delhi.
- William R G and Vanden Berg G E. (1968), Soil Dynamics in Tillage and Traction, Agricultural Research Service, USA.

Elfm.4205 Hydraulic Drives and Controls 3(2+1)

Objective:

To impart basic knowledge in Hydraulic systems by understanding the Fundamental Concepts, understanding of basic laws, system components, application in agricultural engineering and improve the related problem solving skills.

Theory

Module I

(9 Hours)

Basics of Hydraulic: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Colour Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements. Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors.

Module II**(9 Hours)**

Pumps, Pump Classifications, operation, performance, Displacement, Design of Gear Pumps, Vane Pumps, Piston Pumps.

Module III**(9 Hours)**

Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors. Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves.

Module IV**(9 Hours)**

Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs).

Practical

Introduction to hydraulic systems. Study of hydraulic pumps, hydraulic actuators. Study of hydraulic motors, hydraulic valves, colour codes and circuits. Building simple hydraulic circuits, hydraulics in tractors. Introduction to pneumatics, pneumatics devices, pneumatics in agriculture; Use of hydraulics and pneumatics for robotics.

Lecture schedule

1. Basics of Hydraulic: Pascal's Law, Flow, Hydraulic Energy, Work, and Power.
2. Hydraulic Systems.
3. Colour Coding, Reservoirs.
4. Strainers and Filters, Filtering Material and Elements.
5. Accumulators.
6. Pressure Gauges and Volume Meters.
7. Hydraulic Circuit, Fittings and Connectors.
8. Pumps, Pump Classifications, operation.
9. Performance, Displacement.
10. Design of Gear Pumps
11. Design of Vane Pumps
12. Design of Piston Pumps
13. Hydraulic Actuators, Cylinders
14. Construction and Applications, Maintenance
15. Hydraulic Motors.
16. Valves, Pressure-Control Valves
17. Construction, Applications and Maintenance of valves
18. Directional- Control Valves
19. Flow-Control Valves
20. Mid-term examination
21. Valve Installation
22. Valve Failures and Remedies
23. Valve Assembly, Troubleshooting of Valves.
24. Hydraulic Circuit Diagrams and Troubleshooting.
25. United States of American Standards Institute USASI Graphical Symbols.
26. Tractor hydraulics.
27. Working and typical settings of tractor hydraulic system.
28. Working and typical settings of tractor hydraulic system.

29. Working and typical settings of tractor hydraulic system.
30. Maintenance of tractor hydraulics system.
31. Nudging system, ADDC.
32. Pneumatics: Air services, logic units, Fail safe and safety systems.
33. Pneumatics: Air services, logic units, Fail safe and safety systems.
34. Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems
35. Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems
36. Programmable Logic Controls (PLCs).

Practical schedule

1. Introduction to hydraulic systems.
2. Study of hydraulic pumps.
3. Study of hydraulic actuators.
4. Study of hydraulic motors.
5. Study of hydraulic valves.
6. Study of colour codes and circuits.
7. Building simple hydraulic circuits.
8. Hydraulics in tractors.
9. Working and typical settings of tractor hydraulic system
10. Care and Periodic maintenance of tractor hydraulics system
11. Troubleshooting in tractor hydraulics
12. Troubleshooting in tractor hydraulics
13. Introduction to pneumatics
14. Pneumatics devices
15. Pneumatics in agriculture
16. Use of hydraulics for robotics.
17. Use of pneumatics for robotics
18. Practical examination

Suggested Readings

- Er. R. K. Rajput. 2013. Text Book of Fluid Mechanics and Hydraulic Machines. S Chand Publications and Company Pvt. Ltd.
- Kepner RA, Roy Bainer and Barger E. L. 2005.Principles of Farm Machinery.3rd edition.CBS Publications and Distributors Pvt. Ltd.
- Khurmi, R. S. and Khurmi, N. 2014.Hydraulics, Fluid Mechanics and Hydraulic Machines. S Chand Publications and Company Pvt. Ltd.

Elfm.4206 Precision Agriculture and Management 3(2+1)

Objective:

To impart basic knowledge in Precision Agriculture, use of GIS based or sensor based modern equipment for precision farming, system approach in machinery selection and improve the related problem solving skills.

Theory

Module I

(7 Hours)

Precision Agriculture – need and functional requirements. Familiarization with issues relating to natural resources.

Module II (11 Hours)
Familiarization with equipment for precision agriculture including sowing and planting machines, power sprayers, land clearing machines, laser guided land levellers, straw-chopper, straw-balers, grain combines, etc.

Module III (9 Hours)
Introduction to GIS based precision agriculture and its applications. Introduction to sensors and application of sensors for data generation. Database management.

Module IV (9 Hours)
System concept. System approach in farm machinery management, problems on machinery selection, maintenance and scheduling of operations. Application to PERT and CPM for machinery system management

Practical

Familiarization with precision agriculture problems and issues. Familiarization with various machines for resource conservation. Solving problems related to various capacities, pattern efficiency, system limitation, etc. Problems related to cost analysis and inflation and problems related to selection of equipment, replacement, break-even analysis, time value of money etc.

Lecture schedule

1. Introduction to Precision Agriculture
2. Precision Agriculture
3. Need and functional requirements
4. Concept of Protected Cultivation
5. Climate control in protected cultivation
6. Familiarization with natural resources
7. Issues relating to natural resources
8. Familiarization with equipment for precision agriculture.
9. Sowing machines
10. Planting machines
11. Sprayers and power sprayers
12. Land clearing machines
13. Laser guided land levellers
14. Straw-chopper
15. Straw-balers
16. Graincombines
17. Machines for Intercultural operations
18. Horticultural tools, etc.
19. Introduction to GIS based precision agriculture
20. Mid-term examination
21. Methods of Remote Sensing
22. Applications of GIS in precision agriculture
23. Introduction to sensors
24. Application of sensors for data generation
25. Integrated electronic communications for Tractor and equipment's
26. Integrated electronic communications for Tractor and equipment's
27. Variable Rate Technology

28. Familiarization with image processing and data interpretation
29. Database management
30. System concept
31. System approach in farm machinery management
32. Problems on machinery selection
33. Problems on machinery selection
34. Farm machinery maintenance
35. Scheduling of operations
36. Application to PERT and CPM for machinery system management.

Practical schedule

1. Familiarization with precision agriculture.
2. Familiarization with problems and issues of precision agriculture.
3. Familiarization with various machines for resource conservation.
4. Familiarization with protected cultivation – Greenhouse, Glasshouse etc.
5. Problem solving on GIS.
6. Problem solving on GIS.
7. Integrated electronic communications for Tractor and equipment's
8. Variable Rate Technology
9. Familiarization with image processing and data interpretation
10. Solving problems related to system limitation.
11. Problems related to cost analysis.
12. Problems related to inflation
13. Problems related to selection of equipment.
14. Problems related to replacement of equipment.
15. Problems related to break-even analysis.
16. Problems related to time value of money etc.
17. Problems related to PERT and CPM.
18. Practical examination

Suggested Readings

- Brahma Singh, Balraj Singh, Naved Sabir and Murtaza Hasan, 2014. *Advances in Protected Cultivation*. New India Publishing Agency, New Delhi.
- Donell Hunt, 2013. *Farm Power and Machinery Management*. 10th edition. MedTec Publishers, New Delhi.
- Jana, B. L., 2008. *Precision Farming*. AgroTech Publishing Academy.
- Kali Charan Sahu, 2008. *Text Book of Remote Sensing and Geographical Information Systems*. Atlantic Publishers and Distributors Pvt Ltd.
- K. Radha Manohar and C. Ignathinathane. 2015. *Greenhouse Technology and Management*. 2nd edition. B. S. Publications.
- Robert *et.al.* 2011. *Precision Farming Tools: Variable-Rate Application*. Virginia Cooperative Extension. Publ. 442-505. Online Address : https://pubs.ext.vt.edu/442/442-505/442-505_PDF.pdf
- Zelenin, A. N., Balovnev, V. I. and Kerov, I. P. 1986. *Machines for Moving the Earth*. Oxian Press, New Delhi.

Elfm.4207 Photovoltaic Technology and Systems 3(2+1)

Objective

To impart basic knowledge in Solar PV Technology, its effective use, commercial installation, components and improve the related problem solving skills.

Theory

Module I (9 Hours)

Solar PV Technology: Advantages, Limitations, Current Status of PV technology, SWOT analysis of PV technology. Types of Solar Cell, Wafer based Silicon Cell, Thin film amorphous silicon cell Thin Cadmium Telluride (CdTe) Cell, Copper Indium Gallium Selenide (CiGS) Cell, Thin film crystalline silicon solar cell.

Module II (9 Hours)

Solar Photo Voltaic Module: Solar cell, solar module, solar array, series & parallel connections of cell, mismatch in cell, fill factor, effect of solar radiation and temperature on power output of module, I-V and power curve of module.

Module III (9 Hours)

Balance of Solar PV system: Introduction to batteries, battery classification, lead acid battery, Nickel Cadmium battery, comparison of batteries, battery parameters, and Charge controller: types of charge controllers, function of charge controller, PWM type, MPPT type charge controller, Converters: DC to DC converter and DC to AC converter.

Module IV (9 Hours)

Application of Solar PV system. Solar home lighting system, solar lantern, solar fencing, solar street light, solar water pumping system, Roof top solar photovoltaic power plant and smart grid.

Practical

Study of V-I characteristics of solar PV system, smart grid technology and application, manufacturing technique of solar array, different DC to DC and DC to AC converter, domestic solar lighting system, various solar module technologies, safe measurement of PV modules electrical characteristics and Commissioning procedure for complete solar PV system.

Lecture Schedule

1. Solar PV Technology.
2. Solar PV Technology: Advantages, Limitations
3. Current Status of PV technology
4. SWOT analysis of PV technology.
5. Types of Solar Cell, Wafer based Silicon Cell,
6. Thin film amorphous silicon cell and Thin Cadmium Telluride (CdTe) Cell.
7. Copper Indium Gallium Selenide (CiGS) Cell
8. Thin film crystalline silicon solar cell.
9. Solar Photo-Voltaic Module: Solar cell.
10. Solar module, solar array.
11. Series and parallel connections of cell.
12. Mismatch in cell, fill factor.
13. Effect of solar radiation and temperature on power output of module
14. Effect of solar radiation and temperature on power output of module

15. I-V and power curve of module.
16. I-V and power curve of module.
17. Balance of Solar PV system: Introduction to batteries.
18. Battery classification,
19. Lead acid battery,
20. Mid term examination
21. Nickel Cadmium battery
22. Comparison of batteries and battery parameters.
23. Charge controller
24. Types of charge controllers
25. Functions of charge controller, PWM type.
26. MPPT type charge controller.
27. Converters: DC to DC converter.
28. DC to AC type converter.
29. Applications of Solar PV system
30. Solar home lighting system
31. Solar lantern, solar street light.
32. Solar fencing.
33. Solar water pumping system.
34. Roof top solar photovoltaic power plant
35. Smart grid.
36. Smart grid.

Practical schedule

1. Estimation of energy demand by a load.
2. Study of I-V characteristics of solar PV system.
3. PV cell manufacturing technology.
4. Efficiency of PV system.
5. Smart grid technology and its applications.
6. Procedure for building a solar cell array.
7. Procedure for maintaining optimum system voltage.
8. Construction and operation of DC to AC converters.
9. Construction and operation of solar pumping system.
10. Troubleshooting of PV modules.
11. Troubleshooting of PV modules.
12. Troubleshooting of PV modules.
13. Safety precautions for PV modules and solar array.
14. Switching and relays for PV system.
15. Switching and relays for PV system.
16. Electrical characteristics of solar PV system.
17. Commissioning procedure for complete solar PV system.
18. Practical examination

Suggested Readings

- Buresch, Mathew. 1983. Photo-voltaic energy systems : Design and Installation. McGraw-Hill Book Company, New York.
- Derrick, Francis and Bokalders, Solar Photo-voltaic Products.
- Meinel&Meinel. Applied Solar Energy.
- Rai GD. 1998. Non-conventional Sources of Energy. Khanna Pub.

Rathore N.S., Kurchania A.K., Panwar N.L. 2006. Renewable Energy: Theory & Practice, Himanshu Publications.

Solanki C.S. 2011. Solar Photovoltaic: Fundamentals, Technologies and Applications, PHI Learning Private Ltd.

Elfm.4208 Mechatronics 3(2+1)

Objective

To impart basic knowledge in mechatronics, different control systems associated sensors and output signals, modelling, robotics and improve the related problem solving skills.

Theory

Module I (9 Hours)

Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach. Sensors and transducers, performance terminology, Displacement, Position & Proximity Sensors, photo-electric transducers, flow transducers, optical sensors and transducers.

Module II (9 Hours)

Actuators, Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor. Signal conditioning process, filtering digital signal, multiplexers, data acquisition, digital signal processing, measurement system, pulse modulation, data presentation systems.

Module III (9 Hours)

System modelling & control, Mathematical Models, Engineering Systems, Electro-mechanical & Hydraulic-mechanical Systems, Modelling Dynamic Systems, Transfer Functions, Control Modes, PID Controller. Micro-processor & computer, Computer and Interfacing, Micro-computer Structure, Micro-controllers, Application of Microcontrollers, PLC.

Module IV (9 Hours)

Robotics, Robot components, robot classification and specification, Work envelopes, other basic parameters of robots. Robot applications, Robot applications in manufacturing, Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Future applications.

Practical

Selection of sensor for a particular application from Catalogue/Internet. Design a mechatronics product/system and incorporate application of mechatronics for enhancing product values. To study the hardware and software of mechatronics kit. To move a table in X-direction within the range of proximity sensors using Control-X software. To run a motor with PLC. To run a conveyor with computer. To study the movement of actuating cylinders and sensors.

Lecture Schedule

1. Definition of mechatronics, measurement system.
2. Control systems, Microprocessor based controllers, mechatronics approach.
3. Sensors and transducers, performance terminology.
4. Displacement, Position & Proximity Sensors.
5. Photo-electric transducers and Flow transducers.
6. Optical sensors and transducers.

7. Actuators, Mechanical Actuation Systems.
8. Hydraulic & Pneumatic Actuation Systems
9. Electrical Actuation Systems, A.C. Motor, D.C. Motor, Stepper Motor.
10. Signal conditioning process
11. Filtering digital signal, multiplexers, data acquisition.
12. Digital signal processing
13. Measurement system.
14. Pulse modulation,
15. Data presentation systems.
16. System modelling & control.
17. Mathematical Models.
18. Engineering Systems.
19. Electro-mechanical Systems.
20. Mid-term examination
21. Hydraulic-mechanical Systems
22. Modelling Dynamic Systems
23. Transfer Functions,
24. Control Modes, PID Controller.
25. Micro-processor & computer
26. Computer and Interfacing.
27. Micro-computer Structure
28. Micro-controllers.
29. Application of Microcontrollers, PLC.
30. Robotics, Robot components.
31. Robot classification and specification,
32. Work envelopes, other basic parameters of robots.
33. Robot applications, Robot applications in manufacturing.
34. Material transfer and machine loading/unloading.
35. Processing operations like Welding & painting.
36. Assembly operations, Inspection automation, Future applications.

Practical Schedule

1. Selection of sensor for a particular application from Catalogue/Internet.
2. Design a mechatronics product/system.
3. Design a mechatronics product/system.
4. Incorporation of application on mechatronics product for enhancing product values.
5. Incorporation of application on mechatronics product for enhancing product values.
6. Working of A.C. Motor, D.C. Motor, Stepper Motor
7. Working of A.C. Motor, D.C. Motor, Stepper Motor
8. To study on Mathematical Models.
9. To study the hardware of mechatronics kit.
10. To study the software of mechatronics kit.
11. To study Engineering Systems.
12. Modelling Dynamic Systems.
13. To move a table in X-direction within the range of proximity sensors using Control-X software.
14. To run a motor with PLC.
15. To run a conveyor with computer.
16. To run a conveyor with computer
17. To study the movement of actuating cylinders and sensors.
18. Practical examinations

Suggested Readings

Bolton, W. 2004. Mechatronics. Pearson Education Asia.

Craig, J.J. 2008. Introduction to Robotics. Pearson Education Asia.

Doebelin E.O. 2004. Measurement Systems. Mc-Graw Hill.

Mahind, A.P. 1992. Introduction to Digital Computer Electronics. TMH.

Niku, S.Y. 2009. Introduction to Robotics: Analysis, systems and applications”, Pearson Education Asia.

Wolfram, Stadler. 1995. Analytical Robotics and Mechatronics. Mc-Graw Hill.

Department of Irrigation and Drainage Engineering- Core Courses

Iden. 1101 Engineering Mechanics 3(2+1)

Objectives

- To apply the principles of mechanics to practical engineering problems, identify the structural system, develop a simple mathematical model and carry out its analysis.
- To provide basic concepts and principles of strength of materials.

Theory

Module I (7 Hours)

Basic concepts of Engineering Mechanics. Force systems, Resultant of forces, Moment of a force, Varignon's theorem, Parallel force and couples, Free body diagram and equilibrium of forces.

Module II (9 Hours)

Centroid, Moment of inertia, Frictional forces and its application, Analysis of simple framed structures using methods of joints, methods of sections and graphical method.

Module III (7 Hours)

Simple stresses and strains: Elastic constants, Analysis of plane and complex stresses.

Module IV (12 Hours)

Shear force and bending moment diagrams for determinate structures. Stresses in beams, Torsion, Helical springs.

Practical

Numerical problems on composition and resolution of forces, Magnitude and direction of the resultant force graphically, Position of the resultant force by Varignon's theorem, Problems relating to resultant of force systems, Equilibrium of concurrent – co-planar and non concurrent – co-planar force systems; Numerical problems on centroids of plane figures, symmetrical and unsymmetrical sections; Numerical problems on moment of inertia, section modulus, polar moment of inertia, radius of gyration, Numerical problems on frictional forces, ladder and wedge friction; Analysis of simple trusses by method of joints and method of sections; Analysis of simple trusses by graphical method; Numerical problems on simple stresses and strains; Mohr's Circle for two-dimensional stress systems; Numerical problems on shear force and bending moments; Numerical problems on bending and shearing stresses in beams; Problems on torsion of shafts and helical springs.

Lecture Schedule

1. Fundamentals of engineering mechanics – Force – Effects of a force – Characteristics of a force.
2. Particle, Rigid body. Systems of forces. Principle of physical independence of forces. Principle of transmissibility of forces.
3. Resultant of a system of forces, Method of resolution. Resolved components and resolved parts of a force. Theorem of resolved parts and its applications. Numerical problems.
4. Moments and its applications – Moment of a force. Geometrical representation of moment of a force.
5. Varignon's theorem and its applications. Corollaries of Varignon's theorem. Position of resultant force. Numerical problems.

6. Parallel forces – Resultant of two like and two unlike parallel forces. Centre of parallel forces, Couple – Types of couples, moment of a couple characteristics of a couple. Theorems for couples.
7. Equilibrium of forces – Resultant and equilibrant conditions of equilibrium – Principles of equilibrium. Lami's theorem and its applications. Numerical problems. Stable, unstable and neutral equilibrium.
8. Centre of gravity – Centre of gravity of plane sections from geometrical considerations. Centre of gravity of geometrical sections. Reference axes and axes of symmetry. Centre of gravity by the method of moments. Centre of gravity of sections with cut out holes. Numerical problems.
9. Moment of inertia – Units of M.I, Radius of gyration and Modulus of section. M.I. of plane sections by Routhe's rule. M.I. by the method of integration. M.I. of a rectangular section. Perpendicular axis theorem.
10. M.I. of a circular section. M.I. of hollow rectangular and circular section. Numerical problems.
11. Parallel axis theorem and its applications. M.I. of a triangular section about its base, centre of gravity and vertex. M.I. of a semicircular section. Numerical problems.
12. Friction – Types of friction – Limiting friction. Laws of static and dynamic friction. Angle of friction, cone of friction. Friction of bodies on inclined planes -various cases. Numerical problems.
13. Ladder, Wedge and screw jack friction. Numerical problems.
14. Analysis of perfect frames – Types of frames. Assumptions for the analysis of frames. Equation for a perfect frame. Analytical methods – Method of joints and method of sections.
15. Analysis of perfect frames by method of joints. Numerical Problems.
16. Analysis of perfect frames by the method of sections. Numerical problems.
17. Simple stresses and strains – elasticity – stress – strain relationship – types of stresses – Hooke's law – Young's modulus – problems.
18. Elongation in a bar due to its own weight, varying sections – problems.
19. Linear strain – lateral strain – Poisson's ratio – Volumetric strain of a body subjected to three mutually perpendicular stresses – problems.
20. Mid-term Examination
21. Stress on inclined sections of a bar under tension or compression – state of simple shear – linear strain of the diagonal.
22. Bulk modulus – relation between elastic constants E, K and N – problems.
23. Principal planes – principal stresses – derivation.
24. Mohr's circle – problems.
25. Shear force and bending moment diagrams for cantilever beams – problems.
26. Shear force and bending moment diagrams for simply supported beams – problems
27. SFD and BMD for overhanging beams – problems.
28. Relation between SF, BM and intensity of load – derivation of the equation.
29. Bending stresses in beams – theory of simple bending – neutral axis – moment of resistance – assumptions for bending analysis.
30. Bending stresses in beams of various sections – strength of a section – problems.
31. Shear stress in beams – derivation of the equation for shear stress.
32. Shear stresses in beams of various sections – problems.
33. Torsion-derivation of the torsional equations
34. Power transmitted by a shaft.
35. Strength of a solid shaft and a hollow shaft – problems in the design of shaft.
36. Close and open coiled springs – derivation – problems.

Practical Schedule

1. Resultant of forces in magnitude and direction
2. Graphical study of equilibrium of forces
3. Graphical study of wedge friction
4. Determination of position of resultant force (numerical problems)
5. Numerical problems on centroids and moment of inertia of plane figures, radius of gyration, section modulus and polar moment of inertia, for plane figures, symmetrical and unsymmetrical sections
6. Numerical problems on frictional forces, ladder and wedge friction
7. Analysis of simple trusses by method of joints
8. Analysis of simple trusses by method of sections
9. Analysis of simple trusses by graphical method
10. Numerical problems on simple stresses and strains
11. Determination of resultant stresses for one-dimensional and two-dimensional stress systems
12. Determination of principal stresses and maximum shear stress for two-dimensional stress systems
13. Numerical problems on shear force and bending moments
14. Numerical problems on shear force and bending moments
15. Numerical problems on bending and shearing stresses in cantilever beams
16. Numerical problems on bending and shearing stresses in simply supported beams
17. Problems on torsion of shafts and springs.
18. Final Practical Examination

Suggested Readings

- Bansal R K 2005. A Text Book of Engineering Mechanics. Laxmi Publishers, New Delhi.
- Bansal, R. K. 2014 Engineering Mechanics and Strength of Materials, Laxmi Publications, New Delhi.
- Khurmi R.S. 2001. Strength of Materials S. Chand & Co., Ltd., New Delhi.
- Khurmi, R. S. 2014 A Text Book of Engineering Mechanics, S. Chand and Co. New Delhi.
- Kumar, K. L. 2010 Engineering Mechanics, Tata McGraw Hill Publishing Company, New Delhi.
- Prasad I B 2004. Applied Mechanics and Strength of Materials. Khanna Publishers, New Delhi.
- Prasad I B 2004. Applied Mechanics. Khanna Publishers, New Delhi.
- Prasad, I. B. 2012 A Text Book of Applied Mechanics, Khanna Publishers, New Delhi.
- Ramachandra. 2013 Applied Mechanics, Standard Publishers and Distributors, New Delhi.
- Ramamrutham, S.A 2015 Text Book of Applied Mechanics, Dhanpat Rai and Sons, New Delhi.
- Sundarajan V 2002. Engineering Mechanics and Dynamics. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Timoshenko S and Young D H 2003. Engineering Mechanics. McGraw Hill Book Co., New Delhi.
- Timoshenko, 2010 Strength of Materials Vol .I & II, CBS Publishers & Distributors, New Delhi

Iden. 1202 Fluid Mechanics and Open Channel Hydraulics 3(2+1)

Objectives

- To understand the basic principles, fundamental concepts and theories of fluid mechanics
- To familiarize the behavior of the fluids at rest as well as in motion
- To impart knowledge on static, kinematics and dynamic aspects of fluids

Theory

Module I (11 Hours)

Properties of fluids: Ideal and real fluid. Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, centre of pressure, buoyancy, metacentre and meta centric height, condition of floatation and stability of submerged and floating bodies.

Module II (7 Hours)

Kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flow net. Types of fluid flow, translation, rotation, circulation and vorticity, Vortex motion; Dynamics of fluid flow, Bernoulli's theorem, venturimeter, orifice meter and nozzle, siphon.

Module III (5 Hours)

Laminar and turbulent flow in pipes, general equation for head loss, Darcy Equation, Minor and major hydraulic losses through pipes and fittings, flow through network of pipes, hydraulic gradient and energy gradient; Flow through orifices (Measurement of Discharge, Measurement of Time), Flow through Mouthpieces, Flow over Notches, Flow over weirs, Chezy's formula for loss of head in pipes, Flow through simple and compound pipes.

Module IV (12 Hours)

Open channel design and hydraulics: Chezy's formula, Bazin's formula, Kutter's Manning's formula, Velocity and Pressure profiles in open channels, Hydraulic jump; Dimensional analysis and similitude: Rayleigh's method and Buckingham's 'Pi' theorem, types of similarities, dimensional analysis, and dimensionless numbers.

Practical

Study of manometers and pressure gauges; Verification of Bernoulli's theorem; Determination of coefficient of discharge of venturi-meter and orifice meter; Determination of coefficient of friction in pipeline; Determination of coefficient of discharge for rectangular and triangular notch; Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice; Determination of coefficient of discharge for mouth piece; Determination of meta-centric height, Study of current meter; Velocity distribution in open channels and determination of Manning's coefficient of rugosity.

Lecture Schedule.

1. Definition and classification of fluid, properties of fluid – mass density, specific weight, specific volume and specific gravity
2. Viscosity, Newton's law of viscosity, Surface tension and capillarity
3. Fluid pressure at a point, Pascal's law, Pressure variation in a fluid at a point, absolute, gauge, atmospheric and vacuum pressure
4. Measurement of pressure-manometers.
5. Differential manometers and mechanical gauges

6. Hydrostatics – total pressure and centre of pressure
7. Pressure on immersed surfaces-vertical plane surface, inclined surface
8. Curved surface and pressure diagrams
9. Buoyancy and flotation-expression for buoyant force and centre of buoyancy
10. Metacentre and determination of metacentric height-experimental and analytical method
11. Principle of flotation and stability of floating and submerged bodies
12. Kinematics-types of fluid flow-steady, unsteady, uniform and non-uniform flows, Laminar and turbulent flows, compressible and incompressible flows
13. Rotational and irrotational flows, one, two and three dimensional flows,
14. Vorticity, vortex motion-free vortex and forced vortex
15. Lagrangian and Eulerian description of fluid motion-continuity equation-continuity equation in three dimensions, velocity and acceleration
16. Path lines, streak lines and stream lines, velocity potential function and stream function
17. Dynamics of fluid flow – Euler's and Bernoulli's equation of motion, application of Bernoulli's equation-venturimeter,
18. Orifice meter, nozzle meter and pitot tube
19. Flow measuring devices-orifices and mouthpieces, notches and weirs classification and flow through them.
20. Midterm examination
21. Flow through pipes – laminar and turbulent flow, head loss in pipes-major and minor losses
22. Hydraulic gradient and total energy line,
23. Flow through network of pipes
24. Power transmission through pipes,
25. Dimensional analysis and similitude – units and dimensions, dimensional homogeneity
26. Rayleigh's method, example problems
27. Buckingham's method, example problems
28. Types of similarities and similitude
29. Dimensionless numbers-Reynold's number, Froude number, Euler's number, Weber's number and Mach's number.
30. Open channel flow-types of flow in channels, velocity distribution
31. Measurement of velocity in channels
32. Current meter, parshall flumes, Cut throat flumes and venturi flumes,
33. Chezy's and Manning's equation
34. Most economical section of channels-Rectangular and trapezoidal.
35. Triangular and circular channel.
36. Specific energy, critical depth and hydraulic jump

Practical Schedule

1. Determination of viscosity
2. Study of manometers and pressure gauges;
3. Verification of pascal's law
4. Determination of hydrostatic forces on plane surface
5. Verification of Archimedes law
6. Determination of meta-centric height;
7. Verification of Bernoulli's theorem;
8. Determination of coefficient of discharge of venturi-meter and orifice meter;
9. Determination of coefficient of friction in pipeline;

10. Determination of minor losses
11. Determination of coefficient of discharge and calibration of rectangular notch;
12. Determination of coefficient of discharge and calibration of triangular notch
13. Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice;
14. Determination of coefficient of discharge for mouth piece;
15. Determination of Manning's and chezy's constant in open channels.
16. Study of current meter, parshall flumes,
17. Cut throat flumes and venture flumes,
18. Practical examination

Suggested Readings

- Bansal, R K. 2010. A text book of fluid mechanics and Hydraulic machines. Laxmi Publications (P) Ltd. New Delhi.
- Chow V T 1983. Open Channel Hydraulics. Mc Graw Hill Book Co., New Delhi.
- Khurmi R .S. 1970. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines S. Chand & Company Limited, New Delhi.
- Lal Jagadish 1985. Fluid Mechanics and Hydraulics. Metropolitan Book Co. Pvt. Ltd., New Delhi.
- Modi P M and Seth S.M.1973.Hydraulics and Fluid Mechanics. Standard Book House, Delhi.

Iden. 1203 Strength of Materials 2(1+1)

Objectives

- To equip the students with the comprehensive methods of structural analysis with emphasis on analysis of elementary structures.
- To give an ability to apply the knowledge of strength of materials on engineering application and design problems.

Theory

Module I (8 Hours)

Slope and deflection of beams using double integration method, Macaulay's method, moment area method and conjugate beam method.

Module II (4 Hours)

Combined bending and axial stresses, Stability of masonry dams. Columns and Struts. Rankines formula.

Module III (5 Hours)

Analysis of statically intermediate beams. Propped beams. Fixed and continuous beam analysis using superposition, three moment equation and moment distribution methods.

Practical

To perform the tension test on M. S. and TMT specimens, to observe the behaviour of materials under load, to calculate the value of E, ultimate stress, permissible stress, percentage elongation etc. and to study its fracture; To perform the compression test on; concrete cylinders & cubes; To perform the bending test on the specimens; M.S. girder, timber beam, R.C.C. beam, and to determine the various physical and mechanical properties; To determine modulus of elasticity of beam using Maxwell's reciprocal theorem; Determination of Modulus of Rigidity of M.S. specimen (torsion test); To study load

deflection and other physical properties of closely coiled helical spring in tension and compression; To perform the Rockwell and Brinell's Hardness tests on the given specimens; To perform the Drop Hammer Test, Izod Test and Charpy's impact tests on the given specimens; To measure workability of concrete by slump test and compaction factor test; To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials.

Lecture Schedule

1. Deflections of beams – relation between slope, deflection and radius of curvature.
2. Deflection of cantilever beams –Problems.
3. Deflection of simply supported beams –Problems
4. Deflection by Macaulay's method – Problems.
5. Deflection by moment area method – Mohr's theorem –cantilever beams – Problems.
6. Deflection by moment area method – Mohr's theorem – simply supported beams – Problems.
7. Deflection by conjugate beam method, cantilever beams – Problems
8. Deflection by conjugate beam method, simply supported beams – Problems
9. Combined bending and direct stresses – eccentric loading – limit of eccentricity – middle third rule for rectangular and other sections.
10. Mid-term Examination
11. Condition for no tension in the sections – Stability of masonry dams – Problems.
12. Columns and struts – assumptions for Euler's column theory – derivation for buckling load for four cases of long columns.
13. Rankine's formula for long columns – Problems.
14. Statically indeterminate beams – Analysis of fixed beams – problems
15. Analysis of continuous beams by Clapeyron's three moment theorem – problems
16. Analysis of continuous beams by Clapeyron's three moment theorem – problems
17. Analysis of continuous beams by moment distribution method – problems
18. Analysis of continuous beams by moment distribution method – problems

Practical Schedule

1. To perform the tension test on M. S. and TMT specimens, to observe the behaviour of materials under load, to calculate the value of E, ultimate stress, permissible stress, percentage elongation etc. and to study its fracture
2. To perform the compression test on concrete cylinders & cubes
3. To perform the bending test on the specimens M.S. Girder, Timber beam, R.C.C. beam, and to determine the various physical and mechanical properties
4. To determine modulus of elasticity of beam using Maxwell's reciprocal theorem
5. Determination of Modulus of Rigidity of M.S. specimen (torsion test)
6. To study load deflection and other physical properties of closely coiled helical spring in tension and compression
7. To perform the Rockwell and Brinell's Hardness tests on the given specimens
8. To perform the Drop Hammer Test, Izod Test and Charpy's impact tests on the given specimens
9. To measure workability of concrete by slump test and compaction factor test
10. To determine the initial and final setting time for cement
11. Numerical Problems on slope and deflection by using double integration method.
12. Numerical Problems on slope and deflection by Macaulay's method
13. Numerical Problems on slope and deflection by moment area method
14. Numerical Problems on slope and deflection by conjugate beam method
15. Numerical Problems on fixed beam for the construction of BMD and SFD

16. Numerical Problems on continuous beam by Clapeyrons theorem of three moments
17. Numerical Problems on continuous beam by moment distribution methods
18. Final Practical Examination

Suggested Readings

- Junarkar S.B. 2001. Mechanics of Structures (Vo-I& II). Choratar Publishing House, Anand.
- Khurmi R.S. 2001. Strength of Materials S. Chand & Co., Ltd., New Delhi.
- Khurmi, R.S. 2010. Theory of Structures, S. Chand & Co., Ltd., New Delhi.
- Ramamrutham S. 2003. Strengths of Materials. Dhanpat Rai and Sons, Nai Sarak, New Delhi.
- S. Ramamrutham & R. Narayan, 2011. Theory of Structures, Dhanpat Rai Publishing Company (P) Ltd.

Iden. 2104 Building Construction and Cost Estimation 2(2+0)

Objective

- To study the properties of building materials, the fundamentals of building construction, building components and the basics of estimation and valuation

Theory

Module I (13 Hours)

Building Materials: Rocks, Stones, Bricks; Tiles, Lime, Cement, Concrete, Sand, Glass, Rubber, Plastics, Iron, Steel, Aluminium & Timber – types, properties and uses.

Module II (6 Hours)

Building construction: Stone masonry, Brick masonry
Building components: Lintels, Arches, stair cases

Mid-term Examination

Module III (6 Hours)

Doors and windows, Roofs, Different types of floors and floorings, Damp proofing and water proofing, Plastering, pointing, white washing, distempering and painting,
Functional requirements of a building, important building components, building construction, Types of agricultural buildings and related needs.

Module IV (10 Hours)

Estimating principle: Methods of estimating, Main items of work, Types of estimates – Preliminary estimates, Detailed Estimates of Buildings, estimate of a small building, Schedule of rates, Analysis of rate, Valuation.

Lecture Schedule.

1. Stone-classification of rocks – Natural bed of stone and its importance. Qualities of good building stone. Common building stones in India. Artificial stones. ISI tests for stones. Uses of stones.
2. Brick-Composition of good brick earth-Harmful ingredients in brick earth - classification of brick according to shape. IS classification – Qualities of good bricks.
3. Manufacture of bricks-Preparation of clay, Moulding, drying and burning. Burning in Hoffman's kiln.
4. Fire clay bricks. Substitute for bricks-concrete blocks, sand lime bricks and fly ash bricks.

5. Qualities of good brick. ISI tests for bricks.
6. Tiles - Common types. Drain tiles, floor tiles and roof tiles. Lime-classification of lime-ISI classification. Uses of lime.
7. Cement-Properties of cement. Composition of cement, Functions of cement ingredients.
8. Setting action of cement, ISI tests for cement -Uses of cement-Different types of cement.
9. Manufacture of cement-Mixing of raw materials-Dry and wet processes. Burning in rotary kiln. Grinding in ball mills and tube mills.
10. Cement concrete-Properties, materials required for C.C and R.C.C. Properties of concrete – W/c. ratio and its importance. Workability of concrete and its measurement. Mixing, transportation and placing of concrete. – curing of concrete – Mortar-types of mortar.
11. Sand, Glass – Types, properties and uses, Rubber, Plastics – Uses of plastics in buildings – P V C pipes and fiber glass reinforced plastics.
12. Iron – Steel – Market forms of steel – Properties of mild steel and hard steel – Uses of steel – Aluminium – Properties of aluminium – Evaluation as a building material – Economy of using aluminium
13. Timber – Qualities of good timber – Seasoning of timber– Preservation of timber – Market forms of timber – Industrial forms of Timber
14. Stone masonry – technical terms – classification of stone masonry –
15. Brick masonry – technical terms – Bonds in brickwork – Features of English bond and Flemish bond
16. Plan and elevation of English bond for various wall thicknesses.
17. Plan and elevation of Flemish bond for various wall thicknesses.
18. Arches – technical terms – Classification of Arches – Lintels – Types of lintels
19. Stairs – Technical terms used – Types of Stairs
20. Mid-Term Examination
21. Doors and Windows – Technical terms used – Types of Doors and Windows
22. Roofs – Classification of Roofs – Roofing materials – Different types of A C sheets, G I sheets and FRP sheets.
23. Floors and floorings – Types – Damp Proofing and water proofing – methods
24. Plastering, pointing, white washing distempering and painting,
25. Functional requirements of a building, important building components,
26. Types of agricultural buildings and related needs
27. Estimating principle, main items of work, deductions for openings
28. Earthwork calculations
29. R.C.C. work, Estimation for Flooring, Roofing, Plastering, Doors, Windows, Wood Work, Iron Work, Aluminum work and Lump sum items
30. Types of estimates, Detailed and abstract estimate
31. Method of building estimate – separate or individual wall method
32. Centre line method
33. Detailed estimate of a small building
34. Detailed estimate of a small building
35. Schedule of rates – Analysis of rates, Purpose and factors affecting the rate of items
36. Valuation, methods of valuation, book value, market value, scrap and salvage value

Suggested Readings

- Chakrabarti, M. 2002. Estimating, Costing, Specification and Valuation on Civil Engineering. Calcutta.
- Duggal, S K. Building materials.New Age International Publishers.

Dutta, B. N. 2014. Estimating and Costing in Civil Engineering, UBS Publishers Pvt. Ltd., New Delhi.

I. S. 1200 – Methods of Measurement of Buildings and Civil Engineering Works.

I. S. I. – National Building Code of India.

Parbin Singh. Civil Engineering Materials, S. K. Kataria and Sons, Delhi

Punmia, B. C. Building Construction, A. Sauraby and Company Pvt. Ltd., Delhi.

Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain. 2012. Building Construction.Laxmi Publications (P) Ltd., New Delhi.

Rangwala S C. 1994. Engineering Materials.Charotar Publishing House, Anand

Rangwala, S. C. 2012. Building Construction, Charotar Publishing House, Anand.

Sane Y.S. Planning and Designing of Buildings.

Sharma, S. K. Building Construction, S. Chand & Co., Delhi.

Sushil Kumar, Engineering Materials, Metropolitan Book Company, New Delhi.

Iden. 2205 Design of Structures 2(1+1)

Objectives

- To learn the basic concepts of design and perform analysis and design of structural steel members and its connections.
- To understand the concepts of working stress method and to analyse and design reinforced concrete structural elements.

Theory

Module I

(6 Hours)

Loads and use of BIS Codes. Design of riveted and welded connections. Design of structural steel members in tension, compression and bending.

Module II

(6 Hours)

Analysis and design of singly and doubly reinforced sections, Shear, Bond and Torsion. Design of T Beams.

Mid-term Examination

Module III

(5 Hours)

Slabs, Columns, Footings, Retaining walls and Silos.

Practical

Different types of steel sections for beams, tension members, compression members and built-up compression members– Different types of welded and riveted connections– Design and drawing of singly reinforced beam and doubly reinforced beam–T beams– Design and drawing of one way and two way slabs– Design and drawing of cantilever retaining wall.

Lecture Schedule

1. Design of steel structures – Concept of design of steel structures – Structural sections for steel – Use of IS codes and Hand books.
2. Riveted connections – Failures of riveted joints – Strength of a riveted joint – rivet value – Efficiency of the joint – Assumptions for the design of riveted connections – Design of riveted connections – Problems.
3. Welded connections – Parts of weld – Advantages and disadvantages of welded connections – Different types of welds –IS specifications for butt welds and fillet welds– Design of butt welds and fillet welds – Problems.

4. Design aspects of tension members – Effective net sectional area – Design of axially loaded tension members – Design problems.
5. Steel columns and compression members – Euler’s crippling load – Merchant-Rankine formula – Slenderness ratio – Design aspects of axially loaded compression members and struts – Problems in axial load computation and design.
6. Analysis of steel beams – Use of relevant tables for the design – Design aspects of laterally unsupported beams only – Check for shear, deflection and bearing.
7. Design of concrete structures – Concept of analysis and design – Working stress method of design – Factor of safety based on stress and load – Grades of concrete and steel – characteristics of concrete and steel – Assumptions for the design of RCC structural elements.
8. Balanced and unbalanced sections – Balanced design – Balanced section as an economical and critical section – Fundamental equations for design – Design constants – Computation of design loads – Use of IS codes.
9. Analysis of singly reinforced beams – Different types of problems
10. Mid-term Examination
11. Design of singly reinforced beams
12. Analysis of doubly reinforced beams – problems – Revised elastic theory and steel beam theory
13. Analysis of T beams – Different types of problems.
14. Analysis of slabs – one way and two way – Problems – Design of two way slabs by IS code method only.
15. Design aspects of RCC columns – short and long – Problems.
16. Design aspects of RCC footings – Design problems – square footing only.
17. Retaining walls – Types – structural aspects.
18. Bins and silos – Structural aspects of RCC bins and silos.

Practical

1. Numerical problems on riveted connections
2. Numerical problems on welded connections
3. Numerical problems on tension members in steel
4. Numerical problems on compression members in steel
5. Numerical problems on simple beams in steel
6. Numerical problems on singly reinforced beam
7. Design of singly reinforced beam
8. Numerical problems on doubly reinforced beam
9. Design and detailing of singly reinforced beam
10. Numerical problems on T beam
11. Design and detailing of T beam
12. Design and detailing of one way simply supported slabs
13. Design and detailing of unrestrained two way slabs by IS code method
14. Design and detailing of restrained two way slabs by IS code method
15. Numerical problems on short columns in concrete by IS code method
16. Numerical problems on long columns in concrete by IS code method
17. Design and detailing of square column and footing
18. Final Practical Examination

Suggested Readings

Ramachandra, Design Of Steel Structures Vol. I & II. Scientific Publishers-Jodhpur
 Ramamrutham, S. and Narayan, R. 2016. Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Co Pvt Ltd.

Ramamrutham, S.Design Of Steel Structures. DhanpatRai Publishing Company (p) Limited
SushilKumar.2003. Treasure of R.C.C. Design. R.K. Jain. 1705-A, NaiSarak , Delhi-110006, P.B.1074.
Vazirani, V.N.&.Ratwani, M.M. 2013. Design of Reinforced Concrete Structures.KhannaPublishers.

Iden. 2206 Irrigation Engineering 3(2+1)

Objective

- To acquaint and equip the students with the basic principles of Soil-Plant Water relations and their interactions and to develop competency to design water conveyance systems and surface irrigation systems in the field.

Theory

Module I (4 Hours)

Water resources utilization & Irrigation development, Major and medium irrigation schemes of India, purpose of irrigation, environmental impact of irrigation projects, source of irrigation water, measurement of irrigation water: weir, flumes, orifices and other methods;

Module II (14 Hours)

Open channel water conveyance system: design and lining of irrigation field channels. On farm structures for water conveyance, control & distribution; underground pipe conveyance system: components and design; land grading: criteria for land levelling, land levelling design methods, estimation of earth work;

Module III (9 Hours)

Soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil water potential, soil moisture characteristics, soil moisture constants, measurement of soil moisture, moisture stress and plant response; water requirement of crops: concept of evapotranspiration (ET), measurement and estimation of ET.

Module IV (8 Hours)

Irrigation requirement of crops, depth of irrigation, frequency of irrigation, irrigation efficiencies Surface methods of water application: border, check basin and furrow irrigation – adaptability, specification and design considerations.

Practical

Measurement of soil moisture by different soil moisture measuring instruments;
Measurement of irrigation water; Measurement of infiltration characteristics;
Determination of bulk density, Determination of Field capacity and wilting point;
Estimation of evapotranspiration-Direct methods, Estimation of evapotranspiration-In direct methods. Land grading exercises, Design of underground pipeline system; Estimation of irrigation efficiency; Study of advance, recession and computation of infiltration opportunity time; Infiltration by inflow-outflow method; Evaluation of border irrigation method, Evaluation of furrow irrigation method; Evaluation of check basin irrigation method.

Lecture Schedule

1. Water resources utilization & Irrigation development – Present status, Irrigation Potential -Created and Utilized, Causes for gap in Potential created and utilized.
2. Irrigation-Definition, Purpose-Sources of irrigation water-Major and medium irrigation schemes of India.
3. Environmental impact of irrigation projects-Environmental Impact Assessment, Inter Basin Water Transfer.
4. Measurement of irrigation water: Units of measurement – Methods of Water measurement in Open Channels – weir, flumes and orifices and other methods;
5. Flow measurement in pipes. Difference between Pipe Flow and Open Channel Flow
6. Open channel water conveyance system – Types of Open Channels – Types of Open Channel Flow
7. Design of irrigation field channels, Discharge capacity of a channel ,
8. Seepage in canals and field channels, Measurement of seepage in canals ,Materials for lining canals and field channels
9. On farm structures for water conveyance, control & distribution ;Drop Structures Chute Spillways Pipe Drop Spillways,
10. Check Gates , Portable Check Dams ,Turnouts , Siphon Tubes , Flumes , Culverts ,Inverted Siphons
11. Cost analysis of surface Irrigation distribution systems
12. Underground pipe conveyance system: Advantages– Types of pipes for underground pipeline system-
13. Testing of pipes-Discharge capacity, Underground pipeline structures.
14. Design of underground pipe conveyance system-Laying out of Underground Pipeline System –
15. Operation and Maintenance of Underground Pipeline Systems, Cost analysis
16. Land Levelling – Levelling Layout of field for Irrigation and Drainage Systems – Survey and Staking – criteria for land levelling,
17. Land levelling design methods – Plane Method , Profile Method, Plan Inspection Method, Contour Adjustment Method
18. Land levelling design methods- contd, Estimation of earth work-Equipments for Land Grading
19. Soil water plant relationship – soil properties influencing irrigation management, Soil Water Relations
20. Mid Term Examination
21. Kinds of Soil Water, soil water movement-steady and unsteady flow.
22. Infiltration Characteristics of the soil – Infiltration Process – Infiltration Equations
23. Measurement of Infiltration – Factors Affecting Infiltration
24. Soil water potential – Soil Moisture Constants
25. Soil moisture characteristics, Measurement of soil moisture,
26. Water requirement of crops, Concept of Evapotranspiration (ET)-Different terminologies-Actual ET, PET, Consumptive use.
27. Estimation and measurement of ET-Direct methods.
28. Indirect methods of estimation of ET.
29. Water and irrigation requirement of crops, Depth of irrigation, frequency of irrigation, Irrigation interval, Irrigation period.
30. Irrigation efficiencies
31. Surface methods of water application-Border – adaptability, specification.
32. Border system – design considerations.
33. Surface methods of water application – Check Basin – adaptability, specification.
34. Check Basin – design considerations.

35. Surface methods of water application-Furrow – adaptability, specification
36. Furrow-design considerations

Practical

1. Measurement of soil moisture by different soil moisture measuring instruments;
2. Measurement of soil moisture by different soil moisture measuring instruments;
3. Measurement of irrigation water;
4. Measurement of infiltration characteristics;
5. Determination of bulk density,
6. Determination of Field capacity and wilting point;
7. Estimation of evapotranspiration-Direct methods.
8. Estimation of evapotranspiration-In Direct methods.
9. Estimation of evapotranspiration-In Direct methods.
10. Land grading exercises
11. Land grading exercises
12. Design of underground pipeline system;
13. Estimation of irrigation efficiency;
14. Study of advance, recession and computation of infiltration opportunity time;
15. Infiltration by inflow-outflow method;
16. Evaluation of border irrigation method;
17. Evaluation of furrow irrigation method; Evaluation of check basin irrigation method.
18. Practical Examination

Suggested Readings

- Allen R. G., L. S. Pereira, D. Raes, M. Smith. 1998. Crop Evapotranspiration guidelines for computing crop water requirement. Irrigation and drainage Paper 56, FAO of United Nations, Rome.
- Israelsen O.W, Hansen V. E and Stringham G. E. 1980.Irrigation Principles and Practice, John Wiley & Sons, Inc. USA.
- MajumdarD. K.2013. Irrigation Water Management Principles.PHI learning Private Limited New Delhi 2nd Edition.
- Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing House New Delhi.
- Murthy VVN. 2013. Land and Water Management Engineering. Kalyani Publishers, New Delhi.

Iden. 3107 Sprinkler and Micro - Irrigation Systems 2(1+1)

Objectives

- To introduce the concept of micro - irrigation
- To design Sprinkler and Drip irrigation systems

Theory

Module I

(6 Hours)

Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation systems; design of sprinkler irrigation system: layout selection, hydraulic design of lateral, sub-main and main pipe line, design steps; selection of pump and power Module for sprinkler irrigation system; performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency;

Module II**(7 Hours)**

Micro Irrigation Systems: types-drip, spray, & bubbler systems, merits and demerits, different components; Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection, hydraulics of drip irrigation system, design steps; necessary steps for proper operation of a drip irrigation system;

Module III**(5 Hours)**

Maintenance of micro irrigation system: clogging problems, filter cleaning, flushing and chemical treatment; fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation.

Practical

Study of different components of sprinkler irrigation system; design and installation of sprinkler irrigation system; determination of precipitation pattern, discharge and uniformity coefficient; cost economics of sprinkler irrigation system; study of different components of drip irrigation; design and installation of drip irrigation system; determination of pressure discharge relationship and emission uniformity for given emitter; study of different types of filters and determination of filtration efficiency; determination of rate of injection and calibration for chemigation/fertigation; design of irrigation and fertigation schedule for crops; field visit to micro irrigation system and evaluation of drip system; cost economics of drip irrigation system.

Lecture Schedule

1. Sprinkler irrigation: adaptability, problems and prospects
2. Types of sprinkler irrigation systems
3. Design of sprinkler irrigation system: layout selection,
4. Hydraulic design of lateral, sub-main and main pipe line
5. Design steps; selection of pump and power module for sprinkler irrigation system
6. Performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency
7. Micro-Irrigation Systems: types-drip, spray, & bubbler systems, merits and demerits
8. Micro Irrigation Systems: different components
9. Design of drip irrigation system: general considerations, wetting patterns,
10. Mid Examination.
11. Design of drip irrigation system: irrigation requirement, emitter selection
12. Hydraulics of drip irrigation system
13. Design steps; necessary steps for proper operation of a drip irrigation system
14. Maintenance of micro irrigation system: clogging problems
15. Filter cleaning, flushing and chemical treatment
16. Fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system
17. Fertigation frequency, duration and injection rate.
18. Methods of fertigation.

Practical Schedule

1. Study of different components of sprinkler irrigation system, Design and installation of sprinkler irrigation system
2. Determination of precipitation pattern, discharge and uniformity coefficient ,Cost economics of sprinkler irrigation system
3. Study of different components of drip irrigation, Design and installation of drip irrigation system
4. Study of different types of filters, Determination of filtration efficiency
5. Determination of rate of injection and calibration for chemigation/fertigation
6. Design of irrigation and fertigation schedule for crops
7. Evaluation of drip system, Determination of pressure discharge relationship and emission uniformity for given emitter, Cost economics of drip irrigation system.
8. Field visit to micro- irrigation system
9. Practical Examination

Suggested Readings

- Choudhary M.L and Kadam U.S 2006. Micro irrigation for cash crops Westville Publishing House.
- Keller Jack and Bliesner Ron D. 2001. Sprinkle and Trickle Irrigation. Springer Science+ business Media, New York .
- Mane M.S and Ayare B.L. and MagarS.S.2006.Principles of Drip Irrigation systems, Jain Brothers, New Delhi.
- Mane M.S. and Ayare B.L.2007. Principles of Sprinkler Irrigation systems, Jain Brothers, New Delhi.
- Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Pub. House New Delhi.
- Michael AM, Shrimohan and KR Swaminathan. Design and evaluation of irrigation methods, (IARI Monograph No.1). Water Technology Centre, IARI New Delhi.
- Sivanappan R.K., 1987 “Sprinkler Irrigation”, Oxford and IBH Publishing Co., New Delhi.
- Suresh, R., 2010“Principles of Micro-Irrigation Engineering”, Standard Publishers Distributors, New Delhi.

Iden. 3108 Drainage Engineering 2(1+1)

Objectives

- To understand the basic concepts for planning, design and management of land drainage works in cultivated areas
- To study the various methods of land drainage and its impact on environment

Theory

Module I

(3 Hours)

Water logging – causes and impacts; drainage, objectives of drainage, familiarization with the drainage problems of the state;

Module II

(6 Hours)

Surface drainage: Surface drainage coefficient, types of surface drainage, design of surface drains; sub-surface drainage: purpose and benefits, investigations of design parameters-hydraulic conductivity, drainable porosity, water table; derivation of Hooghoudt's and Ernst's drain spacing equations.

Module III**(4 Hours)**

Subsurface drainage system: Design of subsurface drainage system; drainage materials, drainage pipes, drain envelope; layout, construction and installation of drains. Drainage structures.

Module IV**(4 Hours)**

Special drainage systems: vertical drainage; bio-drainage; mole drains. Salt balance, reclamation of saline and alkaline soils, leaching requirements, conjunctive use of fresh and saline water.

Practical

In-situ measurement of hydraulic conductivity by single auger hole and inverse auger hole method; Estimation of drainage coefficients; installation of piezometer and observation wells; preparation of iso-bath and isobar maps; determination of drainable porosity; design of surface drainage systems; design of gravel envelope; design of subsurface drainage systems; determination of chemical properties of soil and water; study of drainage tiles and pipes; installation of sub-surface drainage system; cost analysis of surface and sub-surface drainage system.

Lecture Schedule

1. Water logging – causes and impacts
2. Drainage, objectives of drainage
3. Familiarization with the drainage problems of the state
4. Surface drainage coefficient
5. Types of surface drainage. Design of surface drains;
6. Sub-surface drainage: purpose and benefits
7. Investigations of design parameters-
8. Hydraulic conductivity drainable porosity water table;
9. Derivation of Hooghoudt's and Ernst's drain spacing equations.
10. Mid Term Examination
11. Design of subsurface drainage system;
12. Drainage materials drainage pipes and drain envelope
13. Layout construction and installation of drains.
14. Drainage structures
15. Special drainage systems: vertical drainage; bio-drainage; mole drains
16. Salt balance- reclamation of saline and alkaline soils
17. Leaching requirements.
18. Conjunctive use of fresh and saline water.

Practical Schedule

1. *In-situ* measurement of hydraulic conductivity by single auger hole and inverse auger hole method
2. *In-situ* measurement of hydraulic conductivity by single auger hole and inverse auger hole method
3. Estimation of drainage coefficients
4. Estimation of drainage coefficients
5. Installation techniques of piezometer
6. Installation techniques of observation wells
7. Preparation of isobath
8. Preparation of isobar maps /water contour maps
9. Determination of drainable porosity

10. Design of surface drainage systems
11. Design of subsurface drainage systems,
12. Design of gravel envelope
13. Determination of chemical properties of soil and water
14. Study of drainage tiles and pipes
15. Installation techniques of sub-surface drainage system
16. Cost analysis of surface drainage system.
17. Cost analysis of sub-surface drainage system.
18. Practical Examination

Suggested Readings

- Bhattacharya AK and Michael AM. 2013. Land Drainage, Principles, Methods and Applications. Vikas Publication House, Noida (UP).
- FAO Irrigation and Drainage Paper No. 6, 9, 15, 16, 28 and 38. Rome, Italy.
- Kadam U.S., Thokal R.T., Gorantiwar S.D. and Powar A.G. 2007. Agricultural Drainage-Principles and Practices, Westville Publishing House.
- Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II 5th Edition. Jain Brothers Publication, New Delhi.
- Ritzema, H.P., 1994 "Drainage Principles and Applications", Publication No. 16, International Institute of Land Reclamation and Improvement, Netherlands.

Iden. 3209 Ground Water, Wells and Pumps 3(2+1)

Objectives

- To acquaint and equip the students with the occurrence, development and hydraulics of ground water flow
- To understand the theories and application of wells and pumps
- To impart knowledge in areas of water supply and groundwater development

Theory

Module I (5 Hours)

Occurrence and movement of ground water; aquifer and its types; groundwater exploration techniques; classification of wells, fully penetrating tube wells and open wells, familiarization of various types of bore wells.

Module II (8 Hours)

Groundwater hydraulics-steady and unsteady state flow to wells – Dupuits theory, determination of aquifer parameters by different methods such as Theis, Jacob and Chow's, Theis recovery method; design of open wells; design of tube well and gravel pack, installation of well screen.

Module III (9 Hours)

Methods of drilling of wells: percussion, rotary, reverse rotary; completion and development of well; well losses and well efficiency, well interference, multiple wells systems, estimation of ground water potential, quality of ground water; artificial groundwater recharge techniques.

Module IV (13 Hours)

Pumping systems: water lifting devices; different types of pumps, classification of pumps, component parts of centrifugal pumps, priming, pump selection, installation and

trouble shooting, performance curves, effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics; deep well turbine pump and submersible pump.

Practical

Verification of Darcy's Law; study of different drilling equipments; sieve analysis for gravel and well screens design; estimation of specific yield and specific retention; testing of well screen; estimation of aquifer parameters by Theis method, Coopers-Jacob method, Chow method; Theis Recovery method; well design under confined and unconfined conditions; estimating ground water balance; study of artificial ground water recharge structures; study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pumps, turbine, propeller and other pumps; installation of centrifugal pump; study of hydraulic ram, testing of centrifugal pump and study of cavitations; study and testing of submersible pump.

Lecture Schedule.

1. Occurrence and movement of ground water,
2. Aquifer and its types
3. Groundwater exploration techniques
4. Classification of wells, open wells,
5. Fully penetrating tube wells and familiarization of various types of bore wells
6. Hydraulics of flow in wells – steady flow
7. Unsteady flow-determination of aquifer parameters by different methods such as Theis and Jacob
8. Chow's method and Theis recovery method;
9. Design of open well
10. Design of open well contd.
11. Design of tube well
12. Design of tube well contd.
13. Gravel pack design and installation of well screen, types and losses in well screen
14. Methods of Construction of wells-open wells
15. Methods of drilling of tube wells-percussion, rotary
16. DTH drilling, core drilling, calyx core drilling and diamond core drilling
17. Development of well-different methods
18. Development of well-different methods contd.
19. Yield testing, Sanitary protection of tube well
20. Midterm examination
21. Well interference, multiple well systems
22. Estimation of ground water potential, quality of ground water;
23. Artificial groundwater recharge techniques;
24. Pumping systems: Indigenous water lifts-different types
25. Working of Indigenous water lifting devices
26. Types of pumps – principle of pumping and classification
27. Positive displacement and variable displacement pumps
28. Reciprocating pump-principles and working
29. Centrifugal pumps:-components, principles and working
30. Total pumping head, NPSH, maximum suction lift, power requirement in pumping
31. Centrifugal pumps: performance curves
32. Centrifugal pumps: priming, pump selection, installation and trouble shooting,

33. Effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics;
34. Accessories of centrifugal pumps, multistage pumps ,
35. Deep well turbine and submersible pumps
36. Mixed flow pumps, propeller pumps, axial flow pumps, jet and air lift pumps

Practical schedule

1. Verification of Darcy's Law
2. Study of different drilling equipments;
3. Sieve analysis for gravel and well screens design;
4. Estimation of specific yield and specific retention;
5. Estimation of aquifer parameters by Theis,
6. Estimation of aquifer parameters – Coopers-Jacob, Chow method
7. Theis Recovery method;
8. Open well design
9. Tube well design
10. Estimating ground water balance;
11. Study of artificial ground water recharge structures;
12. Study of radial flow and mixed flow centrifugal pumps,
13. Multistage centrifugal pumps, turbine, propeller and other pumps;
14. Installation of centrifugal pump;
15. Study of hydraulic ram,
16. Testing of centrifugal pump and study of cavitations;
17. Study and testing of submersible pump.
18. Practical examination

Suggested Readings

- H.M Reghunath 2003. Ground water, Wiley Eastern Ltd.
- Michael AM, Khepar SD. and SK Sondhi. 2008. Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill.
- Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II, 5th Edition. Jain Brothers Publication, New Delhi.
- Todd David Keith and Larry W. Mays. 2004. Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow).

Department of Irrigation and Drainage Engineering- Electives

Elid. 4201 Management of Canal Irrigation System 3 (2+1)

Objectives

- To familiarize the students with the canal irrigation system, its components, alignment and performance indicators.
- To impart knowledge about the estimation of water requirement of crops grown in command areas, to design irrigation canal systems.

Theory

Module I

(8 Hours)

Purpose benefits and ill effects of irrigation; typical network of canal irrigation system and its different physical components; canal classification based on source of water, financial output, purpose, discharge and alignment; canal alignment: general considerations for alignment; performance indicators for canal irrigation system evaluation.

Module II

(10 Hours)

Estimation of water requirements for canal command areas and determination of canal capacity; water duty and delta, relationship between duty, base period and delta, factors affecting duty and method of improving duty; silt theory: Kennedy's theory, design of channels by Kennedy's theory, Lacey's regime theory and basic regime equations, design of channels by Lacey's theory, Use of Garrett's diagram

Module III

(11 Hours)

Maintenance of unlined irrigation canals, measurement of discharge in canals, rostering (canal running schedule) and warabandhi, Seepage losses in canals-measurement – necessity of canal lining: advantages and disadvantages, types of canal lining and desirable characteristics for the suitability of lining materials; design of lined canals;

Module IV

(6 Hours)

Functions of distributaries – head and cross regulators; canal falls, their necessity and factors affecting canal fall; sources of surplus water in canals and types of canal escapes; requirements of a good canal outlet and types of outlet.

Practical

Estimation of water requirement of canal commands; Determination of canal capacity;

Layout of canal alignments on topographic maps, Drawing of canal sections in cutting, full banking and partial cutting and partial banking; Determination of longitudinal section of canals; Design of irrigation canals based on silt theories; Kennedy's theory

Design of irrigation canals based on Lacey's theory, Use of Garret's diagram, Design of lined canals; Formulation of Warabandhi; Study of canal outlets, Study of canal regulators, Study of canal escapes and canal falls.

Lecture schedule

1. Irrigation – Purpose, benefits and ill effects
2. Introduction to Canal irrigation system
3. Canal Irrigation network-Different physical components.
4. Canal classification based on source of water,
5. Financial output-purpose of canal irrigation.
6. Canal Discharge
7. Canal alignment: general considerations for alignment;
8. Performance indicators for canal irrigation system evaluation.
9. Estimation of water requirements for canal command areas
10. Determination of canal capacity;
11. Irrigation terminologies-Water duty, delta and Base period
12. Relationship between duty, base period and delta,
13. Factors affecting duty and method of improving duty
14. Design of channels –Silt Theories.
15. Canal design by Kennedy's theory,
16. Lacey's regime theory and basic regime equations,
17. Design of channels by Lacey's theory-
18. Use of Garrett's diagram
19. Midterm examination
20. Maintenance of unlined irrigation canals
21. Measurement of discharge in canals,
22. Canal water distribution – Rostering
23. Canal running schedule and Warabandhi,
24. Seepage losses in canals-measurement
25. Necessity of canal lining:
26. Advantages and disadvantages of lining
27. Types of canal lining
28. Desirable characteristics for the suitability of lining materials;
29. Design of lined canals;
30. Design of lined canals-contd
31. Functions of distributaries – head and cross regulators;
32. Canal falls – their necessity
33. Factors affecting canal fall; Sources of surplus water in canals
34. Types of canal escapes;
35. Requirements of a good canal outlet
36. Types of outlet.

Practical

1. Estimation of water requirement of canal commands;
2. Estimation of water requirement of canal commands
3. Determination of canal capacity;
4. Layout of canal alignments on topographic maps,
5. Drawing of canal sections in cutting, full banking and partial cutting and partial banking;
6. Determination of longitudinal section of canals;
7. Design of irrigation canals based on silt theories; Kennedy's theory
8. Design of irrigation canals based on silt theories; Kennedy's theory
9. Design of irrigation canals based on Lacey's theory
10. Design of irrigation canals based on Lacey's theory

11. Use of Garret's diagram
12. Design of lined canals;
13. Design of lined canals-contd
14. Formulation of warabandhi;
15. Study of canal outlets,
16. Study of canal regulators
17. Study of canal escapes and canal falls.
18. Practical Examination

Suggested Readings

- Arora, K.R. 2001. Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.
- Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.
- Sahasrabudhe SR. 2011. Irrigation Engineering and Hydraulic structures. SK Kataria & Sons Reprint 2015.

Elid. 4202 Minor Irrigation and Command Area Development 3(2+1)

Objectives

- To familiarize students about the basic concepts of Irrigation Management and command area development.
- To impart knowledge about the functioning of Irrigation projects and their performance aspects, activities of command area development authorities and on farm irrigation activities.

Theory:

Module I (7 Hours)

Major, medium and minor irrigation projects -their comparative performance; Factors affecting performance of irrigation projects, Development and utilization of water resources through different minor irrigation schemes. Types of minor irrigation systems in India;

Module II (10 Hours)

Lift irrigation systems: feasibility, type of pumping stations and their site selection, design of lift irrigation systems; Tank Irrigation: grouping of tanks, storage capacity, supply works and sluices;

Module III (13 Hours)

Command area development (CAD) programme – components, need, and scope, and development approaches, historical perspective. Command area development authorities-functions and responsibilities; on farm development works, reclamation works, use of remote sensing techniques for CAD works,

Module IV (5 Hours)

Water productivity: concepts and measures for enhancing water productivity; Farmers' participation in command area development; Case studies of some selected commands;

Practical

Preparation of command area development layout plan; Land Levelling design for a field

Irrigation water requirement of crops; Irrigation water requirement of crops; Preparation of irrigation schedules; Planning and layout of water conveyance system; Design of surplus weir of tanks; Determination of storage capacity of tanks; Design of intake pipe and pump house, Case studies of command areas, Field visits to command areas

Lecture Schedule

1. Major, medium and minor irrigation projects
2. Factors affecting performance of irrigation projects-
3. Factors affecting performance of irrigation projects-contd.
4. Comparative performances of Irrigation projects
5. Development and utilization of water resources through different minor irrigation schemes
6. Development and utilization of water resources through different minor irrigation schemes contd.
7. Types of minor irrigation systems in India;
8. Lift irrigation systems: feasibility
9. Types of pumping stations and their site selection,
10. Types of pumping stations and their site selection-contd.
11. Design of lift irrigation systems;
12. Design of lift irrigation systems-contd.
13. Tank Irrigation:
14. Grouping of tanks
15. Storage capacity
16. Supply works
17. Sluices
18. Mid Semester examination
19. Basic concepts of command area
20. Definitions and terminologies
21. Command area development (CAD) programme – components,
22. Need, scope, and development approaches.
23. Historical perspective,
24. Command area development authorities
25. Functions and responsibilities of CADA
26. Planning and execution of on farm developmental activities
27. Planning and execution of on farm developmental activities contd.
28. Reclamation works
29. Reclamation works contd.
30. Use of remote sensing techniques for CAD work
31. Use of remote sensing techniques for CAD work
32. Water productivity:
33. Concepts and measures for enhancing water productivity
34. Farmers' participation in command area development;
35. Case studies of some selected commands
36. Case studies of some selected commands

Practical Schedule

1. Preparation of command area development layout plan;
2. Land Levelling design for a field
3. Land Levelling design for a field
4. Irrigation water requirement of crops;
5. Irrigation water requirement of crops;
6. Preparation of irrigation schedules;
7. Preparation of irrigation schedules;
8. Planning and layout of water conveyance system;
9. Planning and layout of water conveyance system;
10. Design of surplus weir of tanks;
11. Determination of storage capacity of tanks;
12. Determination of storage capacity of tanks;
13. Design of intake pipe and pump house.
14. Design of intake pipe and pump house
15. Case studies of command areas
16. Case studies of command areas
17. Field visits to command areas
18. Practical Examination

Suggested Readings:-

- Arora, K.R. 2001. Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.
- Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.
- Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Publ. House New Delhi.
- Sahasrabudhe SR. 2011. Irrigation Engineering and Hydraulic structures. SK Kataria & Sons Reprint 2015.

Elid. 4203 Water Quality and Management Measures 3 (2+1)

Objective

To acquaint and equip the students with different aspects of water quality, standards, analysis, decontamination and management aspects.

Theory

Module I (8 Hours)

Natural factors affecting quality of surface water and groundwater, water quality objectives in relation to domestic, industrial and agricultural activities,

Module II (4 Hours)

Drinking water quality standards, irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria.

Module III (5 Hours)

Point and non-point water pollution sources, water contamination due to inorganic and organic compounds, water contamination related to agricultural chemicals, food industry, hydrocarbon and synthetic organic compounds. Arsenic and fluoride contamination in groundwater and remedial measures

Module IV

(18 Hours)

Water decontamination technologies, cultural and management practices for using poor quality water for irrigation.

Practical

Water quality analysis and classification according to USSL and AICRP criteria; soil chemical analysis and estimation of lime and gypsum requirements; study of salinity development under shallow and deep water table conditions; study of contamination movement and transport in soil profile; study of different water decontamination techniques; study of different cultural and management practices for using poor quality water for irrigation; field visit to industrial effluent disposal sites.

Lecture Schedule

1. Introduction-Natural factors affecting quality of surface water and groundwater-
2. Pollution and Contamination-Definition of terms
3. Sources of surface water pollution
4. Types of water pollution – Physical, Chemical and Bacteriological pollution
5. Quality of ground water – Physical, Chemical and Bacteriological aspects
6. Sources of salinity,
7. Measures of water quality
8. Acid and salt affected soils-Lime and Gypsum requirements for amendment.
9. Water quality criteria – Domestic, Industrial, Agricultural activities
10. Drinking water quality standards
11. Irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria.
12. Water quality guidelines for irrigation
13. Point and non-point water pollution sources
14. Water contamination due to inorganic and organic compounds
15. Water contamination related to agricultural chemicals
16. Water contamination related to food industry, hydrocarbon and synthetic organic compounds.
17. Arsenic and fluoride contamination in groundwater and remedial measures
18. Mid Exam
19. Water decontamination technologies-Screening
20. Plain sedimentation
21. Sedimentation aided with coagulation
22. Filtration-types of filters
23. Disinfection-methods
- 24, 25 Water softening
26. Miscellaneous methods of water treatment
- 27, 28 Irrigation with poor quality water-Improvement of water quality
29. Cultural and management practices for using poor quality water for irrigation-Choice of salt tolerant crops
30. Use of fertilizers. Soil management practices
31. Lime requirement of reclamation of acid soils
32. Irrigation management with poor quality water
- 33, 34 Special problems in using poor quality irrigation water
35. Irrigation with sewage effluent
36. Environmental legislation on water pollution in India and abroa

Practical Schedule

1. Water quality analysis-Physical tests
2. Water quality analysis-Chemical tests
3. Water quality analysis-Chemical tests
4. Bacteriological tests for water
5. Bacteriological tests for water
6. Classification according to USSL and AICRP criteria
7. Soil chemical analysis
8. Estimation of lime and gypsum requirements;
9. Study of salinity development under shallow and deep water table conditions;
10. Study of contamination movement and transport in soil profile;
11. Study of different water decontamination techniques;
12. Study of Slow sand filters
13. Study of Rapid sand and Pressure filters
- 14, 15 Study of different cultural and management practices for using poor quality water for irrigation;
16. Field visit to water treatment plants
17. Field visit to industrial effluent disposal sites.
18. Practical exam

Suggested Readings

1. FAO. 1996. Control of water pollution from agriculture – FAO irrigation and drainage paper 55.
2. Gray, N.F. Water Technology. Raj Kamal Electric Press, Kundli, Haryana.
3. Hussain, S.K. 1986. Text Book of Water Supply and Sanitary Engineering. Oxford & IBH Publishing Co. New Delhi.
4. Manahan, S.E. 2009. Fundamentals of Environmental Chemistry. CRC Press, New York.
5. McGauhey, P.H. 1968. Engineering Management of water quality. McGraw Hill Book Company, New York.
6. Minhas, P.S. and Tyagi, N.K. 1998.Guidelines for irrigation with saline and alkali waters. Bull. No, 1/98, CSSRI, Karnal, p. :36.
7. Punmia, B.C. and Lal, P.B.B. 1981. Irrigation and water power engineering. Standard Publishers Distributors, Delhi.
8. Micheal, A.M 2011.Irrigation –Theory and Practice,Vikas Publishing House pvtltd.,New Delhi.

Elid.4204 Design and Maintenance of Greenhouse 3 (2+1)

Objective

The agricultural production must be increased to guarantee the food demand of the fast growing population. Students will get acquainted with greenhouse technology and the cultivation aspects which will help them to adopt the technology for increasing production.

Theory

Module 1

(10 Hours)

History and types of greenhouses; importance, function and features of green house; scope and development of green house technology. Location, Planning and various

component of greenhouse; design criteria and calculation; constructional material and methods of construction; covering materials and its characteristics

Module 2 **(7 Hours)**

Solar heat transfer, steady state analysis of green house, Greenhouse heating, cooling, shedding and ventilation systems; Carbon Dioxide generation and monitoring and lighting systems, instrumentation & computerized environmental Control Systems.

Module 3 **(11 Hours)**

Green house irrigation system designs. Types of valves and accessories, fertilization, root substrata and its pasteurization, containers and benches, plant nutrition. Alternative cropping systems; plant tissue culture, chemical growth regulation;

Module 4 **(7 Hours)**

Disease control; integrated pest management; postproduction quality and handling – Cost analysis of greenhouse production; Applications of green house & its repair & maintenance.

Lecture schedule

1. History and types of greenhouses
2. Importance of green house
3. Function and features of green house
4. Scope and development of green house technology.
- 5 & 6. Location, planning and various components of greenhouse
- 7 & 8. Design criteria and calculation
- 9 & 10. Constructional material and methods of construction
11. Covering materials and its characteristics
12. Solar heat transfer
13. Steady state analysis of green house
14. Greenhouse heating and cooling
15. Shedding and ventilation systems
16. Carbon Dioxide generation and monitoring and lighting systems
17. Instrumentation & computerized environmental Control Systems.
18. Mid-exam
- 19 & 20. Green house irrigation system designs.
21. Types of valves and accessories
- 22 & 23. Fertigation in greenhouses
24. Root substrata and its pasteurization
25. Containers and benches in polyhouse, plant nutrition.
- 26 & 27. Alternative cropping systems
- 28 & 29. Plant tissue culture, chemical growth regulation
30. Disease control; integrated pest management
- 31 & 32 Postproduction quality and handling
- 33 & 34. Cost analysis of greenhouse production
35. Applications of green house
36. Greenhouse repair & maintenance

Practical

1. Study/visit to a functional green house
2. Planning and layout of green house & associated utilities
3. Material selection for the construction of green house

4. Measurement of temp. using thermistor & thermocouples inside the green house
5. Measurement of humidity, solar radiations & air velocity using various methods
6. Application of psychometric charts
7. Greenhouse irrigation design
8. Estimation of cooling requirements in a green house
9. Estimation of ventilation requirements
10. Thermal performance of green house
11. Application of data loggers for simultaneous estimation & control of different parameters like temp., RH, solar radiations etc.
12. Calculations of environment indices inside a green house
13. Fertigation calculations for greenhouse
14. Structural analysis of green house
- 15 & 16. Economic analysis of green house
17. Visit to a commercial green house
18. Practical examination

Suggested Reading

Manohar, K.R. and Iga Thinathane. C. *Greenhouse technology and management*. B.S.Publications, Hyderabad.

Nelson, P.V. *Greenhouse operation and maintenance*. Publisher: Prentice Hall, 2011. ISBN 10: 0132439360 ISBN 13: 9780132439367.

Prasad and Kumar. 2012. *Greenhouse management for horticulture crops*.

Agrobios (India), Jodhpur

Salokhe, V.M. and Sharma, A.K. 2012. *Greenhouse technology and applications*. GeetaSomani Agrotech publishing Academy, Udaipur.

Elid.4205 Landscape Irrigation Design and Management 3 (2+1)

Objective

To acquaint students with the design and management of landscape irrigation systems

Theory

Module I

(8 Hours)

Conventional method of landscape irrigation- hose irrigation system, quick release coupling system and portable sprinkler with hose pipes; Modern methods of landscape irrigation- pop-up sprinklers, spray pop-up sprinkler, drip irrigation and bubblers; Merits and demerits of conventional and modern irrigation systems,

Module II

(9 Hours)

Types of landscapes and suitability of different irrigation methods, water requirement for different landscapes, Segments of landscape irrigation systems, Main components of modern landscape irrigation systems and their selection criteria; types of pipes, pressure ratings, sizing and selection criteria;

Module III

(9 Hours)

Automation system for landscape irrigation- main components, types of controllers and their application,

Module IV

(9 Hours)

Design of modern landscape irrigation systems, operation and maintenance of landscape irrigation systems.

Practical

Study of irrigation equipments for landscapes; Design and installation of irrigation system for landscape, determination of water requirement. Determination of power requirement, pump selection. Irrigation scheduling of landscapes, Study of irrigation controllers and other equipments, Use of AutoCAD in irrigation design: blocks & symbols, head layout, zoning and valves layout, pipe sizing, Pressure calculations etc., Visit to landscape irrigation system and its evaluation.

Lecture Schedule

1. Conventional method of landscape irrigation- hose irrigation system,
2. Quick release coupling system
3. Portable sprinkler with hose pipes;
4. Modern methods of landscape irrigation- pop-up sprinklers,
5. Modern methods of landscape irrigation- spray pop-up sprinkler,
6. Modern methods of landscape irrigation- drip irrigation
7. Modern methods of landscape irrigation- bubblers;
8. Merits and demerits of conventional systems
9. Merits and demerits of modern irrigation systems
10. Types of landscapes and suitability of different irrigation methods,
11. Water requirement for different landscapes
12. Segments of landscape irrigation systems
13. – 14. Main components of modern landscape irrigation systems
15. Components of modern landscape irrigation systems - their selection criteria
16. Types of pipes, pressure ratings
17. Pipe sizing and selection criteria
18. Mid exam
19. Automation system for landscape irrigation- main components,
20. Types of Automation controllers and their application,
21. Design of modern landscape irrigation systems - Site Survey,
- 22,23. Design of modern landscape irrigation systems - Determining Maximum Flow Rate and Working Pressure,
- 24,25. Design of modern landscape irrigation systems - Plant Water Requirements,
26. Design of modern landscape irrigation systems - Zoning
27. Operation and maintenance of landscape irrigation systems - Landscape Irrigation Control Zones,
28. Bubbler/Water Harvesting Irrigation Systems,
29. Turf Sprinkler Irrigation Systems - Sprinkler Patterns,
30. Turf Sprinkler Irrigation Systems - Sprinkler System Evaluation,
31. Turf Sprinkler Irrigation Systems - Efficiency, and Uniformity,
- 32, 33. Turf Sprinkler Irrigation Systems - System Design,
34. Turf Irrigation Systems - Subsurface Drip Irrigation
- 35,36. Turf Sprinkler Irrigation Systems - Maintenance and Economics

Practical Schedule

1. Study of irrigation equipment for landscapes
2. -3. Design and installation of irrigation system for landscape
4. -5. Determination of water requirement
6. Determination of power requirement, pump selection.

7. Irrigation scheduling of landscapes
8. Study of irrigation controllers and other equipment
9. Use of AutoCAD in irrigation design: blocks & symbols
10. Use of AutoCAD in irrigation design: head layout
11. Use of AutoCAD in irrigation design: zoning and valves layout
12. Use of AutoCAD in irrigation design: pipe sizing
- 13-15. Use of AutoCAD in irrigation design: Pressure calculations etc.,
- 16-17 Visit to landscape irrigation system and its evaluation
18. Practical exam

Suggested Readings

- Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Publ. House New Delhi.
- Rain Bird Landscape Irrigation Design Manual. 2000.
(<http://www.rainbird.com/documents/turf/IrrigationDesignManual.pdf>). Rain Bird Sprinkler Manufacturing Corporation.
- Singh Neeraj Partap. 2010. Landscaping Irrigation & Floriculture Terminology, ISBN: 8181895118, 978-8181895110, *Ibdc* Publishers, Bangalore.
- Stephen W. Smith, 1997. Landscape Irrigation: Design and Management, ISBN: 0471038245, 9780471038245, John Wiley & Sons, N.Y.
- WALLER, PETER; YITAYEW, MULUNEH.2016.Landscape Irrigation Design and Management. In: WALLER, P.; YITAYEW, M. Irrigation and Drainage Engineering: Springer International Publishing. p. 271--288.

Elid.4206 Applications of Geospatial techniques in Water Resources 3 (2+1)

Objectives:

- i) To introduce the principles and basic concepts of Remote Sensing and GIS
- ii) To introduce the remote sensing systems, data products and analysis
- iii) To introduce the spatial data models, analysis and presentation techniques
- iv) To study the applications of Remote Sensing and GIS in Water Resources – irrigation and drainage.

Theory

Module I Remote Sensing Systems

(9 Hours)

Introduction, Basic concepts of remote sensing, Energy sources and radiation principles, Energy interactions with atmosphere and earth surface features, Spectral reflectance curves, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Multispectral, thermal and hyperspectral sensing.

Module II Digital Image Processing

(7 Hours)

Digital Image Processing - Image restoration, Image enhancement and Information extraction, Image processing software, Digital Elevation Modelling, Sources of digital elevation data, Shuttle Radar Topographic Mission (SRTM) data, DEM for Slope, Aspect, Flow direction, Flow pathways, Flow accumulation, Streams, Catchment area delineation,

Module III Remote Sensing Applications

(7 Hours)

Remote sensing applications for watershed management, Rainfall runoff modelling, Irrigation management, Flood mapping, Drought assessment, Environment and ecology,

Module IV Geographical Information System (9 Hours)

GIS and basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties, Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS,

Module V Advanced Topics (3 Hours)

Advanced Topics - Microwave remote sensing, sources of microwave data, Global positioning System (GPS).

Practical

Familiarization with remote sensing and GIS hardware; use of software for image interpretation; interpretation of aerial photographs and satellite imagery; basic GIS operations such as image display; study of various features of GIS software package; scanning, digitization of maps and data editing; data base query and map algebra. GIS supported case studies in water resources management.

Lecture schedule

1. Introduction, Basic concepts of remote sensing, Airborne and space born sensors, Passive and active remote sensing
2. EMR Spectrum, Energy sources and radiation principles
3. Energy interactions in the atmosphere, Energy interactions with earth surface features, Spectral reflectance curves
4. Satellites and orbits, Polar orbiting satellites
5. Spectral, radiometric and spatial resolutions, Temporal resolution of satellites
6. Multispectral, thermal and hyperspectral sensing.
7. Some remote sensing satellites and their features
8. Geometric corrections
9. Co-registration of Data, Ground Control Points (GCP)
10. Atmospheric corrections, Solar illumination corrections
11. Concept of color, Color composites
12. Contrast stretching – linear and non-linear stretching
13. Filtering techniques, Edge enhancement
14. Density slicing, Thresholding, Intensity-Hue-Saturation (IHS) images, Time composite images, Synergetic images.
15. Multispectral classification, Ground truth collection
16. Supervised and unsupervised classification
17. Change detection analysis, Principal component analysis
18. Mid exam
19. Ratio images, Vegetation indices
20. Image processing software, Multispectral classification algorithms
21. Introduction, Sources of digital elevation data, Types of DEM
22. Radar interferometry, Shuttle Radar Topographic Mission (SRTM) data
23. DEM for Slope, Aspect, Flow direction, Flow pathways, Flow accumulation, Streams, Catchment area delineation
24. Watershed management
25. Rainfall-runoff modeling
26. Irrigation management
27. Flood mapping

28. Drought assessment
29. Environmental monitoring
30. Geographical information system: introduction
31. Components of GIS
32. GIS data models – vector and raster data
33. Coordinate system and geo-referencing
34. Microwave remote sensing, sources of microwave data
35. Global positioning System (GPS)
36. GPS for ground truth collection.

Practical

1. Interpretation of FCC for land use mapping
2. Interpretation of FCC for water resources mapping
3. Digital image processing - image enhancement
4. Digital image processing – image filtering
5. Image classification – unsupervised
6. Image classification – supervised
7. Introduction to GIS software
8. Digital elevation model
9. Preparation of slope map
10. Preparation of aspect map
11. Digitisation
12. DEM application
13. Soil erosion modelling using GIS and RS
- 14, 15. Rainfall runoff modelling using GIS
16. Watershed prioritization using GIS
17. Preparation of water table contour maps
18. Practical Examination

Suggested Readings

- Burrough and McDonnel. Principles of GIS, Oxford University press.
- Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
- George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
- Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.
- Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
- Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
- Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.
- Sahu, K.C. 2008. Text Book of Remote Sensing and Geographic Information Systems. Atlantic Publishers and Distributors (P) Ltd., New Delhi.
- Shultz, G.A. and E.T. Engman. 2000. Remote Sensing in Hydrology and Water Management. Springer, New York

Elid.4207 Environmental Engineering 3 (2+1)

Objective

To familiarize the students with various water treatment and sanitary engineering principles and applications.

Theory

Module I (18 Hours)

Introduction- Types of water demands. Methods of forecasting population. Water quality – physical, chemical and biological water quality parameters. Analysis of water-physical, chemical and bacteriological tests. Water processing- Sedimentation- types of sedimentation tanks – design aspects. Coagulation- principle and purpose-flocculation-mixing devices – jar test. Filtration- theory- classification of filters- double filtration. Disinfection- theory and necessity- methods. Chlorination – forms. Tests for chlorine. Water softening. Colour, odour and taste removal, Iron and manganese removal, defluoridation. Conveyance of water - intakes- design considerations. Pipes and pipe corrosion. Distribution system- design considerations- methods of distribution. Service reservoirs- purposes and types. Systems of supply of water. Wastage of water and its prevention. Pipe appurtenances. Water pollution and its control – point sources and distributed sources – types of water pollution – preventive measures – Eutrophication – Cumulative toxins.

Module II (2 Hours)

Water purification processes in natural systems- physical, chemical and biochemical processes- response of streams to biodegradable organic waste – dissolved oxygen balance – organic discharge and stream ecology.

Module III (9 Hours)

Introduction to sanitary engineering- collection and conveyance of refuse- methods – systems of sewerage. Quantity of sewage- methods of estimation. Construction of sewers. Design of sewers. Sewer appurtenances. Waste water characteristics- physical, chemical and biological. Waste water treatment objectives- classification of treatment methods, application of treatment methods. Physical unit operations, chemical unit operations and biological unit operations. Facilities for physical and chemical treatment of waste water- screens- grit removal – sedimentation tanks – chemical precipitation. Facilities for the biological treatment of waste water – the activated sludge process – aerated lagoons – trickling filters. Sludge disposal. Other methods of sewage treatment – septic tanks – Imhoff tanks.

Module IV (4 Hours)

Natural treatment systems- characteristics and objectives- application.

Practical

Problems on population estimation, Determination of water quality parameters, Design of sedimentation tanks, Design of flocculation tanks, Design of filters, Problems on disinfection, Problems on water softening, Design of sewers, Problems on sewage quality, Problems on disposal in natural streams, Design of sewage treatment plant, Field visit to water treatment plant, Field visit to sewage treatment plant.

Lecture Schedule

1. Introduction- Types of water demands- domestic water demand.
- 2.-3. Methods of forecasting population – arithmetical increase method, geometrical increase method, incremental increase method, decreasing rate method, simple graphical method, comparative graphical method, mater plan (zoning) method, logistic curve method and apportionment method.
- 4.-6. Water quality – physical, chemical and biological water quality parameters, suspended solids, turbidity, colour, temperature, taste and odour, alkalinity, hardness, flouride, total dissolved solids, metals, organics, nutrients, pathogens and pathogen indicator. Water-borne diseases.
- 7.-8. Analysis of water- physical, chemical and bacteriological tests, Measurement of colour, taste, odour and temperature, Turbidimeters, measurement of chlorides, dissolved oxygen, hardness, pH, alkalinity and total solids. Total count test and B-Coli test.
9. Water processing- Sedimentation- theory, purpose and location- types of sedimentation tanks – design aspects.
10. Coagulation- principle and purpose-flocculation-usual coagulants- feeding the coagulants- mixing devices – jar test.
- 11-12. Filtration- theory- classification of filters- slow sand filters- rapid sand filters – pressure filters – double filtration.
- 13-14. Disinfection- theory and necessity- methods – boiling, excess lime treatment, iodine and bromine treatment, U.V. treatment, ozone treatment, potassium permanganate treatment, silver treatment. Chlorination – action of chlorine- application of chlorine – bleaching powder, chloramines and free chlorine gas. Forms of chlorination- plain, pre, post, double, break-point, super and de-chlorination. Tests for chlorine- Orthotolidin and starch-iodide test.
15. Water softening- types of hardness, removal of temporary and permanent hardness- lime-soda process, zeolite process and demineralisation process. Colour, odour and taste removal, Iron and manganese removal, deflouridation.
16. Conveyance of water- intakes- design considerations. Pipes and pipe corrosion.
17. Distribution system- design considerations- methods of distribution. Service reservoirs- purposes and types. Systems of supply of water. Wastage of water and its prevention.
18. Pipe appurtenances- air valves, bib cocks, fire hydrants, reflux valves, relief valves, scour valves, sluice valves, stop cocks and water meters.
19. Water pollution and its control – point sources and distributed sources – types of water pollution – preventive measures – Eutrophication – Cumulative toxins.
20. Water purification processes in natural systems- physical, chemical and biochemical processes- response of streams to biodegradable organic waste – dissolved oxygen balance – organic discharge and stream ecology.
21. Introduction to sanitary engineering- collection and conveyance of refuse- methods – systems of sewerage. Quantity of sewage- dry weather flow and storm water – methods of estimation.

22. Construction of sewers- materials of construction and shapes of sewers. Design of sewers- principles- minimum and maximum velocities- hydraulic formulas.
23. Sewer appurtenances – catch basins, clean-outs, drop manholes, flushing tanks, grease and oil traps, inlets, inverted siphons, lamp holes, man holes, storm regulators.
24. Waste water characteristics- physical, chemical and biological. Waste water treatment objectives- classification of treatment methods, application of treatment methods. Physical unit operations, chemical unit operations and biological unit operations.
- 25.-26. Facilities for physical and chemical treatment of waste water- screens- grit removal – sedimentation tanks – chemical precipitation.
27. - 29. Facilities for the biological treatment of waste water – the activated sludge process – aerated lagoons – trickling filters.
30. Sludge disposal – methods.
31. Natural treatment systems- characteristics and objectives- types- slow rate, rapid infiltration, overland flow, wetlands – constructed and natural, floating aquatic plants. Considerations in application.
32. - 34. Other methods of sewage treatment – septic tanks – Imhoff tanks.

Practical Schedule

- 1, 2. Problems on population estimation.
3. Determination of water quality parameters.
- 4,5. Design of sedimentation tanks.
6. Design of flocculation tanks.
7. Design of filters.
8. Problems on disinfection.
9. Problems on water softening.
- 10,11. Design of sewers.
12. Problems on sewage quality.
13. Problems on disposal in natural streams.
- 14, 15. Design of sewage treatment plant.
16. Field visit to water treatment plant.
17. Field visit to sewage treatment plant.
18. Practical Examination

Suggested Readings

- Garg, S. K. (1992) Environmental Engineering (Vol. I) Water Supply Engineering. Khanna Publishers, Delhi. pp. 656.
- Jahne, Johannes (1964) Technical Fundamentals. Construction Practice in Rural Areas, Part I. Construction of Roads and Tracks in Rural Areas. Asia Publishing House. New Delhi. pp. 96.
- Metcalf and Eddy (1997) Wastewater Engineering - Treatment, Disposal, Reuse. Tata-McGraw-Hill Publishing Co. Ltd. New Delhi. pp. 1334.
- Peavy, H. S., Rowe, D. R. and Tchobanoglous, G. C. (1986) Environmental Engineering. McGraw-Hill Book Co., New York. pp. 700.
- Rangwala, S. C. (1992) Water Supply and Sanitary Engineering. Charotar Publishing House, Anand. pp. 783.

Elid.4208 Numerical Methods in Water Resources 3 (2+1)

Objective:

To familiarize the students with the numerical and computational methods for solution of engineering problems in water resources.

Theory

Module I (6 Hours)

Introduction - Methods of computation and computing systems, instability of algorithms and sensitivity of solution techniques - Approximation methods - classical and modern; Numerical quadrature and integration methods; Stability and convergence; Least square approximation; Initial and boundary value problems; Errors and approximation in digital computers – sources of errors- safeguards

Module II (10 Hours)

Ordinary and partial differential equations, Introduction to differential equations; Differential equations in fluid dynamics; Initial and boundary value problems; difference schemes:- implicit and explicit schemes, accuracy, Consistency, convergence and stability, method of characteristics. Fourier analysis of numerical solutions. Multi-dimensional problems. Diffusion in 2D.

Module III (8 Hours)

Numerical simulation of hydraulic systems, error analysis, error propagation, solution of non-linear hydraulic equations (graphical, Newton-Raphson and bisection methods), solution of a system of linear equations (Gauss elimination, Gauss-Siedel, Thomas algorithm), linear, polynomial and multiple linear regression, Newton's and Lagrange interpolating polynomials, numerical integration (trapezoidal and Simpson's rule), solution of ordinary differential equations (Euler, Runge-Kutta).

Module IV (5 Hours)

Finite Difference Methods: Finite differences for ODE's, Finite differences and solution of PDE, classifications, field problems, The advection equation; The diffusion equation-Initial and boundary conditions; The advection-diffusion equation; Unsteady flow and the Method of Characteristics; Unsaturated subsurface flow, Richard's equation; Coupled saturated-unsaturated subsurface flow.

Module V (6 Hours)

Introduction to finite element method, variational formulation, Method of Lines, FEM application in Subsurface transport. Applications in surface and groundwater hydraulics application to steady and unsteady flows, ground water problems, pollutant dispersion, flood wave propagation, tidal model, application with computer programming.

Practical

Problems on errors in numerical computations, Solution of nonlinear hydraulic equations- graphical method, Newton- Raphson method and Bisection method, Solution of linear hydraulic equations- Gauss elimination method, Gauss – Siedel method, Thomas algorithm, Linear polynomial and multiple linear regression, Numerical integration- trapezoidal and Simpson's rule, Solution of ordinary differential equation – Euler, Runge- Kutta method, Finite difference method- Gauss- Siedel solution of

Laplace's equation, Poisson's equation- drawdown problem, 1D seepage through a dam under Dupuit assumptions, Transient flow- confined aquifer drawdown, Finite element method- solution of Laplace's equation, Finite element method- location of free surface boundary and heads in a dam, Ground water problems, pollutant dispersion, flood wave propagation, tidal model

Lecture schedule

1. Introduction - Methods of computation and computing systems,
2. Instability of algorithms and sensitivity of solution techniques
3. Approximation methods - classical and modern;
4. Numerical quadrature and integration methods;
5. Stability and convergence; Least square approximation;
6. Errors and approximation in digital computers – sources of errors- safeguards
7. Ordinary and partial differential equations, Introduction to differential equations
8. Differential equations in fluid dynamics;
9. Initial and boundary value problems;
10. Difference schemes - implicit
11. Explicit schemes,
12. Accuracy, Consistency,
13. Convergence, stability
14. Method of characteristics
15. Fourier analysis of numerical solutions
16. Multi-dimensional problems
17. Diffusion in 2D.
18. Mid exam
19. Numerical simulation of hydraulic systems
20. Error analysis, error propagation, solution of non-linear hydraulic equations
21. Graphical method, Newton-Raphson and bisection methods
22. Solution of a system of linear equations
23. Gauss elimination, Gauss-Siedel, Thomas algorithm
24. Linear, polynomial and multiple linear regression
25. Newton's and Lagrange interpolating polynomials
26. Numerical integration - trapezoidal and Simpson's rule
27. Solution of ordinary differential equations – Euler method, Runge-Kutta method
28. Finite Difference Methods: Finite differences for ODE's
29. Finite differences and solution of PDE, classifications, field problems
30. The advection equation; The diffusion equation-Initial and boundary conditions
31. The advection-diffusion equation
32. Unsteady flow and the Method of Characteristics,
33. Unsaturated subsurface flow
34. Richard's equation; Coupled saturated-unsaturated subsurface flow.
35. Introduction to finite element method, variational formulation
36. Method of Lines, FEM application in Subsurface transport

Practical Schedule

1. Problems on errors in numerical computations
2. Solution of nonlinear hydraulic equations- graphical method
3. Newton- Raphson method and Bisection method
4. Solution of linear hydraulic equations- Gauss elimination method
5. Gauss – Siedel method
6. Thomas algorithm

7. Linear polynomial and multiple linear regression
8. Numerical integration- trapezoidal and Simpson's rule
9. Solution of ordinary differential equation – Euler, Runge- Kutta method
10. Finite difference method- Gauss- Siedel solution of Laplace's equation
11. Poisson's equation- drawdown problem
12. 1D seepage through a dam under Dupuit assumptions
13. Transient flow- confined aquifer drawdown
14. Finite element method- solution of Laplace's equation
15. Finite element method- location of free surface boundary and heads in a dam
16. Ground water problems, pollutant dispersion,
17. Flood wave propagation, tidal model
18. Practical exam

Suggested reading

- Fetter, C.W. (1980) Applied Hydrogeology. Merrill, Columbus-Ohio, pp 488.
- Forsythe, G.E. and Wasow, W. (1960) Finite Difference Methods for Partial Differential Equations. Wiley, New York, pp 444.
- Huyakorn, P.S. and Pinder, G.F. (1983) Computational Methods in Subsurface Flow. Academic Press, New York.
- Jain, M.K., Iyengar, S.R.K and Jain R.K. (1991) Numerical Methods for Scientific and Engineering Computation. Wiley Eastern Ltd. New Delhi. Pp 470.
- Krishnamurthy, E.V., and Sen, S.K, 2000, Numerical Algorithms- computations in science and engineering. Affiliated East- West Press Pvt. Ltd. New Delhi.
- Pinder, G.F. and Gray, W.G. (1977) Finite Element Simulation in Surface and Subsurface Hydrology, Academic Press, New York, pp 295.
- Smith, G.D. (1965) Numerical Solution of Partial Differential Equations. Oxford University Press, New York, pp 179.
- Vedamurthy, V.N. and Iyengar, N. Ch. S. N. (1998) Numerical Methods, Vikas Publishing House Pvt Ltd., New Delhi.
- Wang, H.F. and Anderson, M.F. (1982) Introduction to groundwater modeling. W. H. Freeman and Co., San Francisco. Pp.237.
- Zienkiewicz, O.C. (1977) The Finite Element Method. McGraw Hill Inc., New York, pp 787.

Elid.4209 Irrigation Structures 3 (2+1)

Theory

Module I (4 Hours)

Principles of design – creep theory – seepage force and safety against piping – inverted filter – uplift pressure – design considerations for protection works.

Module II (7 Hours)

Hydraulic jump as energy dissipater – types – basic characteristics – appurtenances to control jump- stilling basins – standardized designs – SAF and USBR. Channel transitions – structures – principles.

Module III (9 Hours)

Design of stable, unlined earthen channels, stable earthen channels with unprotected banks – general tractive force design methodology – tractive force concepts. Design of

channels in coarse alluviums – Shield’s entrainment method for design of channels with protected banks.

Module IV

(8 Hours)

Structures in small canals – conveyance structures - regulating structures – protective structures – water measurement structures – energy dissipating structures – transition and erosion protection structures.

Module V

(7 Hours)

Spillways, Diversion head works, Outlets.

Practical

Problems on creep theory, uplift pressure, inverted filter etc., Problems on hydraulic jump. Problems on unlined channel with protected/unprotected banks - tractive force concept. Problems on design of channels in coarse alluvium – Shield’s entrainment theory. Design and drawing of : Stilling basins, Drops, Chutes, Flumes, Spillways, Division structures, Turnouts, Culverts.

Lecture Schedule

1-3. Principles of design – creep theory – seepage force and safety against piping – inverted filter – uplift pressure – design considerations for protection works.

4-6. Hydraulic jump as energy dissipator – hydraulic jump – types – basic characteristics – control of jump by abrupt drop – stilling basins – standardized designs – SAF and USBR.

7- 8. Channel transitions – transition structures – principles.

9-11. Design of stable, unlined earthen channels – general tractive force design methodology – tractive force concepts. Design procedure for unlined, stable earthen channels with unprotected banks.

12-13. Design of channels in coarse alluviums – Shield’s entrainment method for design of channels with protected banks.

14. Structures in small canals – conveyance structures - regulating structures – protective structures – water measurement structures – energy dissipating structures – transition and erosion protection structures.

15-17. Conveyance structures – aqueduct, structures for canal crossing

18. Mid exam

19-21. Conveyance structures-drops and chutes.

22-23. Regulating structures – concrete/ masonry checks, turnouts, division structures

24-27. Water measurement structures – flumes, weirs

28-29. Energy dissipators – aprons, stilling wells.

30-32. Spillways.

33. Diversion head works- barrage – fish ladder – silt excluder.

34-36. Outlets – Non-modular, semi-modular and modular.

Practical

1-3. Problems on creep theory, uplift pressure, inverted filter etc.

4-5. Problems on hydraulic jump.

6-8. Problems on unlined channel with protected/unprotected banks - tractive force concept.

9-10. Problems on design of channels in coarse alluvium – Shield’s entrainment theory. Design and drawing of :-

11. Stilling basins

12. Drops
13. Chutes
14. Flumes
15. Spillways
16. Division structures
17. Turnouts and Culverts
18. Practical Examination

Suggested Readings

- Chow, V. T. (1959) Open-Channel Hydraulics. McGraw Hill Book Co., Singapore. pp. 680.
- French, R. H. (1994) Open-Channel Hydraulics. McGraw Hill Inc., New York. pp. 739.
- Garg, S. K. (1987) Irrigation Engineering and Hydraulic Structures. Khanna Publishers. Delhi. pp. 1185.
- Murthy, C. S. (1997) Water Resources Engineering, Principles and Practice. New Age International (P) Ltd., New Delhi. pp. 260.
- Robinson, A. R. (1983) Farm Irrigation Structures. Water Management Synthesis Project. Utah State University, Logan, Utah. pp. 503.

Elid.4210 Climate change and use of Geoinformatics 3 (2+1)

Objective

Theory

Module I

(8 Hours)

Energy issues and climate change: Climate change, global warming and greenhouse effect, greenhouse gases (GHGs) and their sources, quantifying CO₂ and methane emissions, global warming potential (GWP), the radiative balance, earth's carbon reservoirs and carbon cycle. Impacts of climate change in different ecosystem: Models of global and Indian changes including temperature rise, sea level rise, coastal erosion and flooding, positive feedbacks, Climate change refugees.

Module II

(8 Hours)

Controlling carbon dioxide: Efforts to restrict carbon dioxide levels: Kyoto Protocol, recent protocols, methods to increase carbon dioxide absorption in power production, agricultural production, forestry, and industry, the Copenhagen Summit and its implications, future predictions. Carbon Trading: concept of carbon credits.

Module III

(8 Hours)

Introduction, GIS definition and terminology, data types, raster and vector data, GIS database design, spatial database creation – digitization, scanning; processing of data, GIS implementation and project management. Commercially available remote sensing and GIS softwares. Satellite based navigation systems: concepts and applications; map projections and datums, coordinate systems; Survey of India topographical maps types and numbering system. Introduction to the softwares (ArcGIS and Erdas Imagine).

Module IV

(8 Hours)

Climate Change Policy-Mitigation and Adaptation: Carbon storage and sequestration, carbon management through a biotic sequestration- forest ecosystems, wetlands; soil carbon sequestration; bio fuels, carbon farming and carbon trading. Climate change

impact assessment – applications for agriculture and water management. Case studies- Projected impact of climate change on India; temperature, rainfall, forests, agriculture, water resources; India's response to climate change

Practical

Case studies on effects of climate change: greenhouse gas emissions, sea level rise, crop productivity. Case studies on clean development mechanisms. Comparative evaluation of data from IPCC reports and climate scenarios. Case studies on successful green energy initiatives. Familiarization with remotesensing and GIS hardware; use of software for image interpretation-Preparation of maps; Introduction to GIS softwares–Q-GIS, ERDAS, Arc GIS etc. Visual interpretation of satellite imagery; land use mapping-Digital image processing-Exercises in viewing, editing, overlay-GIS supported case studies in climate change and water management.

Lecture schedule

1. Energy issues and climate change
2. Climate change, global warming and greenhouse effect,
3. Greenhouse gases (GHGs) and their sources.
4. Quantifying CO₂ and methane emissions, global warming potential (GWP),
5. The radiative balance, earth's carbon reservoirs and carbon cycle.
6. Impacts of climate change in different ecosystems
- 7, 8. Models of global and Indian changes including temperature rise, sea level rise, coastal erosion and flooding, positive feedbacks, Climate change refugees.
9. Controlling carbon dioxide: Efforts to restrict carbon dioxide levels:
10. Kyoto Protocol, recent protocols.
- 11,12. Methods to increase carbon dioxide absorption in power production, agricultural production, forestry, and industry
13. Copenhagen Summit and its implications, future predictions.
14. Carbon Trading: concept of carbon credits.
15. Introduction- GIS definition and terminology,
16. Data types, raster and vector data,
17. GIS database design, spatial database creation – digitization, scanning; processing of data
18. Mid-exam
19. GIS implementation and project management.
20. Commercially available remote sensing and GIS softwares.
21. Satellite based navigation systems: concepts and applications;
22. Map projections and datums, coordinate systems;
23. Survey of India topographical maps types and numbering system.
- 24, 25, 26. Introduction to ArcGIS and ERDAS Imagine.
- 27, 28. Climate Change Policy-Mitigation and Adaptation:
29. Carbon storage and sequestration
- 30,31. Carbon management through biotic sequestration- forest ecosystems, wetlands, soil carbon sequestration.
- 32,33. Climate change impact assessment – applications for agriculture and water management.
- 34,35,36. Case studies- Projected impact of climate change in India; temperature, rainfall, forests, agriculture, water resources; India's response to climate change.

Practical Schedule

1. Case studies on effects of climate change: greenhouse gas emissions, sea level rise, crop productivity.
2. Case studies on clean development mechanisms.
3. Comparative evaluation of data from IPCC reports and climate scenarios.
4. Case studies on successful green energy initiatives.
- 5, 6 Familiarization with remote sensing and GIS hardware; use of software for image interpretation-Preparation of maps;
- 7, 8 Introduction to GIS software–Q-GIS.
- 9, 10 Overview of GIS software Arc GIS.
11. Coordinate system, Geo-referencing, Attribute data preparation
12. Digitization and creating maps
- 13, 14 Digital image processing-Exercises in viewing, editing, overlay
- 15,16,17 GIS supported case studies in climate change and water management.
18. Practical exam

Suggested Reading

- AkimasaSunii, Kensuke, F., and Ai, Hiramatsu (2010). Adaptation and mitigation strategies for climate change. Springer.
- Burroughs, W.J. (2007). Climate change: A multidisciplinary approach (2nd edition.). Cambridge University Press. Dash,
- Gautam, P.L. Singh, V. and Melkania, U. (Eds.). (2009). Ecosystem diversity and carbon sequestration: climate change challenge and a way out for ushering in a sustainable future. Daya Publishing House, Delhi.
- IPCC (2007): Summary for policymakers. In: Climate change 2007: impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7- 22.
- Lillisand, Thomas, Ralph W. Kiefer and Jonathan Chipman. 2007. Remote Sensing and Image Interpretation. Wiley India.
- Lo, C.P., and Albert K.W. Yeung. 2009. Concepts and Techniques of Geographic Information Systems, 2nd Edition. PHI Learning.
- Sushil Kumar. (2007). Climate change: An Indian perspective. Cambridge University Press India pvt.ltd. New Delhi.

Land and Water Resources and Conservation Engineering-Core Courses

Lwre. 1101 Engineering Drawing 1(0+1)

Objective

To enable the students for making technical drawings of different engineering objects.

Practical

Drawing Instruments and their uses, Types of lines, lettering and dimensioning. Introduction of drawing scales, First and third angle methods of projection. Principles of orthographic projections; Reference planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plane surface; True length and inclination of lines; Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids. Preparation of working drawing from models and isometric views. Drawing of missing views. Concept of sectioning. Revolved and oblique sections.

Practical Schedule

1. Acquaintance of drawing instruments, lettering, curves etc.
2. Study of lettering and exercises
3. Different type of scales
4. Projection – orthographic projection views, plane of projection, first and third angle projection
5. Orthographic projections – points
6. Orthographic projections- lines, parallel to and contained by one or both planes, perpendicular to a plane, inclined to one plane and parallel to other
7. Projection of lines – Projection of lines inclined to both plane, True length and inclination of lines, traces of lines
8. Projection of plane- perpendicular to both plane, perpendicular to one and parallel to other, perpendicular to one and inclined to the other, Traces of planes
9. Auxiliary planes and true shapes of oblique plane surface
10. Auxiliary planes and true shapes of oblique plane surface
11. Projections of solids-simple positions
12. Projection of solid-axis inclined to one plane and parallel to other, axis inclined to both planes
13. Section of solids- concept of sectioning, section plane parallel to one plane, section plane perpendicular to one plane and inclined to other
14. Development of surfaces of geometrical solids
15. Isometric projection of geometrical solids.
16. Preparation of working drawing from models and isometric views. Drawing of missing views.
17. Revolved and oblique sections.
18. Final Practical Examination

Suggested Readings

- Anilkumar K N. 2010 Engineering Graphics. Adhyuth Narayan Publishers, Kottayam
- Bhatt N D. 2010. Elementary Engineering Drawing. Charotar Publishing House Pvt. Ltd., Anand.
- Satheeshpaul. 2015. Engineering Graphics. Paul and Sheldon Publishing, Kothamangalam
- Varghese, P.I 2015. Engineering Graphics. VIP publishers, Thrissur.

Lwre. 1102 Environmental Science and Disaster Management 3(2+1)

Objectives

- To understand the natural environment and its relationships with human activities and to characterize and analyze human impacts on the environment.
- Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Theory

Module I

(10 Hours)

Environmental Studies -Scope and importance. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Module II

(8 Hours)

Ecosystems: Concept, Structure, function, Producers, consumers, decomposers, Energy flow, ecological succession, food chains, food webs, ecological pyramids. Introduction, types, characteristic features, structure and function of the forest, grassland, desert and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Module III

(10 Hours)

Environmental Pollution: definition, cause, effects and control measures of a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Social Issues and the Environment from Unsustainable to Sustainable development, Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Module IV

(8 Hours)

Disaster Management

Natural Disasters and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

Case Studies and Field work. Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc. Expected impact of climate change on agricultural production and water resources, Mitigation Strategies, Economics of climate change. Disaster Management introduction, Natural and Manmade Disaster Studies, Informatics for Disaster Management, Quantitative Techniques for Disaster Management Environmental Impact Assessment (EIA) and Disaster Management Disaster Management Policy Environmental Modelling.

Lecture Schedule

1. Environmental Studies -Scope and importance. Natural Resources: Renewable and non-renewable resources
2. Natural resources and associated problems. a) Forest resources: Use and over-exploitation Deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
3. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems
4. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems
5. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
6. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
7. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
8. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
9. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
10. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.
11. Ecosystems: Concept, Structure, function, Producers, consumers, decomposers,
12. Ecosystems: Concept, Structure, function, Producers, consumers, decomposers,
13. Energy flow, ecological succession, food chains, food webs, ecological pyramids.
14. Energy flow, ecological succession, food chains, food webs, ecological pyramids.
15. Introduction, types, characteristic features, structure and function of the forest, grassland, desert and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

16. Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India.
17. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
18. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity.
19. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
20. Mid Examination
21. Environmental Pollution: definition, cause, effects and control measures of a. Air pollution
22. b. Water pollution c. Soil pollution
23. d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards.
24. Solid Waste Management: causes, effects and control measures of urban and industrial wastes.
25. Role of an individual in prevention of pollution. Pollution case studies. Social Issues and the Environment from Unsustainable to Sustainable development, Urban problems related to energy. Water conservation, rain water harvesting, watershed management.
26. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. dies. Wasteland reclamation. Consumerism and waste products.
27. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act.
28. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion.
29. Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.
30. Natural Disasters and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions,
31. Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.
32. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution,
33. Road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels.
34. Road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels.
35. International strategy for disaster reduction. Concept of disaster management, national disaster management framework;
36. Financial arrangements; role of NGOs, community-based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations

Practical Schedule

1. Case Studies and Field work.
- 2-3. Visit to a local area to document environmental assets river/forest/grassland/hill/mountain,
- 4-5. Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural,
6. Study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.
7. Expected impact of climate change on agricultural production and water resources,
8. Mitigation Strategies,

9. Economics of climate change.
10. Disaster Management introduction,
11. Natural and Manmade Disaster Studies,
12. Informatics for Disaster Management,
13. Quantitative Techniques for Disaster Management
14. Environmental Impact Assessment (EIA) and Disaster Management
15. Environmental Impact Assessment (EIA) and Disaster Management
16. Disaster Management Policy
17. Environmental Modelling.
18. Final Practical Examination

Suggested Readings

- Bharucha Erach. 2005. Text Book of Environmental Studies for Undergraduate Courses. University Grants Commission, University Press, Hyderabad.
- Sharma J P. 2003. Introduction to Environment Science. Lakshmi Publications.
- Chary Manohar and Jaya Ram Reddy. 2004. Principles of Environmental Studies. BS Publishers, Hyderabad.
- Kaul S N, Ashuthosh Gautam. 2002. Water and Waste Water Analysis. Days Publishing House, Delhi.
- Gupta P K. 2004. Methods in Environmental Analysis – Water, Soil and Air. Agro bios, Jodhpur.
- Climate change. 1995: Adaptation and mitigation of climate change-Scientific Technical Analysis Cambridge University Press, Cambridge.
- Sharma, R.K. & Sharma, G. 2005. Natural Disaster. APH Publishing Corporation, New Delhi.
- Husain Majid. 2013. Environment and Ecology: Biodiversity, Climate Change and Disaster Management. online book.

Lwre. 1203 Surveying and Levelling 3(1+2)

Objective

- To introduce the principle of surveying.
- To impart awareness on the various fields of surveying and types of instruments.
- To understand the various method of surveying and computation required in the field of agriculture.

Theory

Module I

(5 Hours)

Surveying – introduction and basic principles – objects and uses of surveying – classification and methods of surveying. Linear measurements – principles in chain surveying – selection of survey stations and lines – types of ranging – direct ranging and indirect ranging – chaining – folding and unfolding of chains – reading the chain – leader and follower and their duties – conventional signs. Types of chains - ranging rod - offsets – types - measurement of offsets – cross staff - optical square. Steps involved in chain survey – reconnaissance - marking stations - reference sketches – running survey lines - booking field notes - plotting a chain survey; Testing of chain - degree of accuracy in chaining – error in length due to incorrect chain - compensating and cumulative errors – mistakes - Chaining on sloping ground – direct and indirect methods – obstacles in chaining - chain and tape corrections. Compass Surveying – Prismatic compass - Surveyor’s compass – whole circle and reduced bearings. True and magnetic bearing – dip and declination - local attraction – traversing – plotting.

Module II

(5 Hours)

Plane table Survey – instruments and accessories – setting up – orientation – different methods – radiation – intersection – traversing. Two point problem – three point problem - advantages and

disadvantages – errors in plane tabling. Levelling – definitions – types of levels – optical principles – sensitivity of bubble – adjustments of levels – types of bench marks – principles in levelling – booking the reading. Reduction of levels – collimation system – problems. Rise and fall system – problem.

Module III

(5 Hours)

Classification of levelling – profile levelling – cross sectioning – plotting – curvature and refraction – contouring – characteristics – uses – different methods – direct and indirect interpolation. Theodolite Surveying – definitions – parts of a theodolite – adjustment of a theodolite – measurement of angles – horizontal angles – different methods – vertical angle.

Theodolite traverses – traverse computations – adjustment of closed traverse – problems. Tacheometric surveying – stadia system – fixed and movable hair methods – instrument constants – anallatic lens – tangential tacheometry. Areas and volumes – mid ordinate rule – average ordinate rule – trapezoidal rule – Simpson's rule – use of planimeter – volumes – trapezoidal and prismoidal formula.

Module IV

(3 Hours)

Minor instruments – Hand levels – Clinometer. Electronic theodolite. Total station – Introduction to total station survey. GPS survey – Introduction to GPS survey

Practical

Chain Surveying, Compass Surveying, Plane Table Surveying – Radiation, Plane Table Surveying – Intersection, Plane Table Surveying – Solving Two Point Problem, Plane Table Surveying – Solving Three Point Problem, Plane Table Surveying – Traversing. Levelling Fly levelling – plane of collimation method, Levelling Fly levelling – rise and fall method, Levelling Longitudinal and Cross sectioning, Levelling Contouring. Theodolite Surveying: Measurement of horizontal angle by repetition method, Theodolite Surveying: Measurement of horizontal angle by reiteration method, Measurement of vertical angle, Theodolite Traversing – closed, Theodolite Traversing – open, Determination of tacheometric constants, Heights and distances by stadia method – line of sight horizontal, Heights and distances by stadia method – line of sight inclined, Heights and distances by tangential method, Heights and distances by tangential method, Heights and distances by solution of triangles, Heights and distances by solution of triangles, Trigonometric levelling – base of the object accessible. Study of minor instruments – hand level – clinometers. Study of electronic theodolite, Total station surveying, GPS surveying.

Lecture schedule

1. Surveying – introduction and basic principles – objects and uses of surveying – classification and methods of surveying.
2. Linear measurements – principles in chain surveying – selection of survey stations and lines – types of ranging – direct ranging and indirect ranging – chaining – folding and unfolding of chains – reading the chain – leader and follower and their duties – conventional signs., Types of chains – ranging rod – offsets – types, measurement of offsets – cross staff – optical square.
3. Steps involved in chain survey – reconnaissance – marking stations – reference sketches – running survey lines – booking field notes – plotting a chain survey; Testing of chain – degree of accuracy in chaining – error in length due to incorrect chain – compensating and cumulative errors – mistakes; Chaining on sloping ground – direct and indirect methods – obstacles in chaining – chain and tape corrections.
4. Compass Surveying – Prismatic compass – Surveyor's compass – whole circle and reduced bearings.
5. True and magnetic bearing – dip and declination – local attraction – traversing – plotting.
6. Plane table Survey – instruments and accessories – setting up – orientation – different methods – radiation – intersection – traversing.

7. Two point problem – three point problem - advantages and disadvantages – errors in plane tabling.
8. Levelling – definitions – types of levels – optical principles – sensitivity of bubble – adjustments of levels – types of bench marks – principles in levelling – booking the reading.
9. Reduction of levels – collimation system – problems. Rise and fall system – problems
10. Mid Examination
11. Classification of levelling – profile levelling – cross sectioning – plotting – curvature and refraction – contouring - characteristics – uses – different methods – direct and indirect interpolation.
12. Theodolite Surveying – definitions – parts of a theodolite – adjustment of a theodolite – measurement of angles – horizontal angles – different methods – vertical angle.
13. Theodolite Surveying – definitions – parts of a theodolite – adjustment of a theodolite – measurement of angles – horizontal angles – different methods – vertical angle.
14. Theodolite traverses – traverse computations – adjustment of closed traverse – problems.
15. Tacheometric surveying- stadia system- fixed and movable hair methods - instrument constants- analytic lens- tangential tacheometry.
16. Areas and volumes - mid ordinate rule – average ordinate rule – trapezoidal rule – Simpson's rule - use of planimeter – volumes – trapezoidal and prismatic formula.
17. Minor instruments – Hand levels – Clinometer. Electronic theodolite.
18. Total station – Introduction to total station survey. GPS survey - Introduction to GPS survey.

Practical Schedule

1. Chain Surveying – 1
2. Chain Surveying – 2
3. Compass Surveying – 1
4. Compass Surveying – 2
5. Plane Table Surveying – Radiation
6. Plane Table Surveying - Intersection
7. Plane Table Surveying – Solving Two Point Problem
8. Plane Table Surveying - Solving Three Point Problem.
9. Plane Table Surveying- Traversing.
10. Levelling Fly levelling- plane of collimation method.
11. Levelling Fly levelling- rise and fall method
12. Levelling Longitudinal and Cross sectioning.
13. Levelling Contouring - 1
14. Levelling Contouring - 2
15. Theodolite Surveying: Measurement of horizontal angle by repetition method.
16. Theodolite Surveying: Measurement of horizontal angle by reiteration method
17. Theodolite Surveying: Measurement of horizontal angle by reiteration method
18. Measurement of vertical angle
19. Measurement of vertical angle
20. Theodolite Traversing – closed
21. Theodolite Traversing – open
22. Determination of tacheometric constants.
23. Heights and distances by stadia method – line of sight horizontal
24. Heights and distances by stadia method - line of sight inclined
25. Heights and distances by tangential method.
26. Heights and distances by tangential method.
27. Heights and distances by solution of triangles.
28. Heights and distances by solution of triangles
29. Trigonometric levelling- base of the object accessible
30. Study of minor instruments- hand level - clinometer

31. Study of electronic theodolite.
32. Total station surveying - 1
33. Total station surveying - 2
34. GPS surveying - 1
35. GPS surveying – 2
36. Final Practical Examination

Suggested Readings

Arora K R 1990. Surveying (Vol.I), Standard Book House, Delhi.
 Kanetkar T P 1993. Surveying and Levelling. Pune Vidyarthi Griha, Prakashan, Pune.
 Punmia, B C 1987. Surveying (Vol.I). Laxmi Publications, New Delhi.
 Rangwala 1991. Surveying and levelling. Charotar Publishing House Pvt. Ltd. Gujarat.

Lwre. 2104 Watershed Hydrology 3(2+1)

Objective

- To familiarize the students with the important aspects of watershed hydrology.
- To impart the knowledge about the various hydrologic phenomena and their relevance in the field of soil and water conservation.

Theory

Module I

(10 Hours)

Hydrologic cycle, precipitation and its forms, rainfall measurement and estimation of mean rainfall, frequency analysis of point rainfall. Mass curve, hyetograph, depth-area-duration curves and intensity-duration-frequency relationship. Hydrologic processes-interception, infiltration -factors influencing, measurement and indices.

Module II

(10 Hours)

Evaporation - estimation and measurement. Runoff - factors affecting, measurement, stage - discharge rating curve, estimation of peak runoff rate and volume, Rational method, Cook's method and SCS curve number method. Geomorphology of watersheds – Linear, aerial and relief aspects of watersheds- stream order, drainage density and stream frequency. Hydrograph - components, base flow separation, unit hydrograph theory, S-curve, synthetic hydrograph, applications and limitations.

Module III

(8 Hours)

Floods – terms and definitions head water flood control- method. Stream gauging - discharge rating curves, flood peak, design flood and computation of probable flood.

Module IV

(8 Hours)

Flood routing – channel and reservoir routing. Drought – classification causes and impacts, drought management strategy.

Practical

Visit to meteorological observatory and study of different instruments. Design of rain gauge network. Exercise on intensity - frequency - duration curves. Exercise on depth - area - duration and double mass curves. Analysis of rainfall data and estimation of mean rainfall by different methods. Exercise on frequency analysis of hydrologic data and estimation of missing data, test for consistency of rainfall records. Exercise on computation of infiltration indices. Computation of peak runoff and runoff volume by Cook's method and rational formula. Computation of runoff volume by SCS curve number method. Study of stream gauging instruments - current meter and

stage level recorder. Exercise on geomorphic parameters of watersheds. Exercise on runoff hydrograph. Exercise on unit hydrograph. Exercise on synthetic hydrograph. Exercise on flood routing.

Lecture schedule

1. Introduction; Hydrologic events
2. Hydrologic cycle
3. Precipitation and its forms
4. Types of precipitation
5. Rainfall measurement – various types of rain gauges
6. Rainfall measurement – various types of rain gauges
7. Estimation of mean rainfall
8. Frequency analysis of point rainfall
9. Mass curve and hyetograph
10. Depth-area-duration curves
11. Intensity-duration-frequency relationship
12. Hydrologic processes-Interception
13. Infiltration -factors influencing. Infiltration measurement and indices
14. Evaporation - estimation and measurement
15. Runoff - factors affecting, measurement of runoff
16. Stage - discharge rating curve
17. Estimation of peak runoff rate and volume, Cook's method
18. Rational method of runoff estimation
19. SCS Curve Number method
20. Mid Examination
21. Geomorphology of watersheds
22. Linear, aerial and relief aspects of watersheds - stream order
23. Linear, aerial and relief aspects of watersheds - stream order
24. Drainage density and stream frequency
25. Hydrograph - Components, base flow separation
26. Unit hydrograph theory, S-curve
27. Unit hydrograph theory, S-curve
28. Synthetic hydrograph, applications and limitations
29. Floods – terms and definitions
30. Head water flood control- method
31. Stream gauging - discharge rating curves
32. Flood peak - design flood
33. Computation of probable flood
34. Flood routing. Channel routing
35. Reservoir routing
36. Drought – classification causes and impacts. Drought management strategy.

Practical schedule

1. Visit to meteorological observatory and study of different instruments
2. Design of rain gauge network
3. Exercise on intensity - frequency - duration curves
4. Exercise on depth - area - duration and double mass curves
5. Analysis of rainfall data and estimation of mean rainfall by different methods
6. Exercise on frequency analysis of hydrologic data and estimation of missing data, test for consistency of rainfall records
7. Exercise on frequency analysis of hydrologic data and estimation of missing data, test for consistency of rainfall records

8. Exercise on computation of infiltration indices
9. Computation of peak runoff and runoff volume by Cook's method and rational formula
10. Computation of peak runoff and runoff volume by Cook's method and rational formula
11. Computation of runoff volume by SCS curve number method
12. Study of stream gauging instruments - current meter and stage level recorder
13. Exercise on geomorphic parameters of watersheds
14. Exercise on geomorphic parameters of watersheds
15. Exercise on runoff hydrograph
16. Exercise on synthetic hydrograph
17. Exercise on flood routing
18. Final Practical Examination

Suggested Readings

- Chow, V.T., D.R. Maidment and L.W. Mays. 2010. Applied Hydrology, McGraw Hill Publishing Co., New York.
- Jaya Rami Reddy, P. 2011. A Text Book of Hydrology. University Science Press, New Delhi.
- Linsley, R.K., M.A. Kohler, and J.L.H. Paulhus. 1984. Hydrology for Engineers. McGraw-Hill Publishing Co., Japan.
- Mutreja, K.N. 1990. Applied Hydrology. Tata McGraw-Hill Publishing Co., New Delhi.
- Raghunath, H.M. 2006. Hydrology: Principles Analysis and Design. Revised 2nd Edition, New Age International (P) Limited Publishers, New Delhi.
- Subramanya, K. 2008. Engineering Hydrology. 3rd Edition, Tata McGraw-Hill Publishing Co., New Delhi.
- Suresh, R. 2005. Watershed Hydrology. Standard Publishers Distributors, Delhi.
- Varshney, R.S. 1986. Engineering Hydrology. Nem Chand and Brothers, Roorkee, U.P.

Lwre. 2205 Soil Mechanics 3(2+1)

Objective

- To impart the students the fundamentals of soil mechanics and to enable the students to understand the basic, index and engineering properties of soil.
- To equip the students to understand the properties and behavior of soil for the design of foundations, earth and earth retaining structures.

Theory

Module I

(10 Hours)

Nature of soil and functional relationships: Formation of soils - Soil type - 3 phase system - void ratio - specific gravity - dry density - porosity - water content - saturated unit weight - submerged unit weight - degree of saturation – Soil Structure: single grained, honey combed, flocculated and dispersed structure and their effects on the basic soil properties.

Laboratory and field identification of soils: Determination of water content by oven drying – Specific gravity using pycnometer and specific gravity bottle - Grain size analysis by sieve analysis, hydrometer analysis and pipette analysis - Atterberg limits and indices – Visual identification by simple field tests – Field density by core cutter, sand replacement and wax coating methods

Classification of soils: Necessity - Principles of classification - I.S. classification – Plasticity charts – Group index.

Module II

(10 Hours)

Soil water: Modes of occurrence – adsorbed and capillary water types - Total stress - Effective stress – Pore pressure - Pressure diagrams

Permeability: Definition - Darcy's law - Factors affecting permeability – Laboratory determination - Stratified soils: average permeability.

Shear Strength: Definition - Mohr's strength and stress circles - origin of planes - Mohr's envelope - Mohr- Coulomb strength theory – Direct shear test – introduction to triaxial shear test- Measurement of pore pressure - Total and effective stress strength parameters - UCC test - Vane shear tests - Choice of test conditions for field problems.

Module III

(8 Hours)

Consolidation: Definition – Spring analogy for primary consolidation - Terzaghi's theory of one dimensional consolidation – Concepts of coefficient of compressibility - Coefficient of volume change and compression index – Laboratory consolidation test - e-log p curves – pre-consolidation pressure - Time rate of consolidation - difference between consolidation and compaction.

Compaction: Definition and objectives of compaction – Standard and Modified Proctor tests- Concept of OMC and maximum dry density - Zero air voids line - Factors influencing compaction - Effect of compaction on soil properties - Field compaction methods – Proctor needle for field control.

Module IV

(8 Hours)

Earth pressure: Earth pressure at rest - Active and passive earth pressure for cohesionless and cohesive soils - Rankine's and Coulomb's theories - Point of application of earth pressure for cases of with and without surcharge in cohesionless and cohesive soils - Culmann's and Rebhan's graphical construction for active earth pressure-

Stability of slopes: Slope failure, base failure and toe failure - Swedish circle method – $\Phi = 0$ analysis and $c = 0$ analysis - Friction circle method - Taylor's stability number – Stability charts.

Practical

Determination of water content of soil; Determination of specific gravity of soil; Determination of field density of soil by core cutter method; Determination of field density by sand replacement method; Grain size analysis by sieving (Dry sieve analysis); Grain size analysis by hydrometer method; Determination of liquid limit by Casagrande's method; Determination of liquid limit by cone penetrometer and plastic limit; Determination of shrinkage limit; Determination of permeability by constant head method; Determination of permeability by variable head method; Determination of compaction properties by standard proctor test; Determination of shear parameters by Direct shear test; Determination of unconfined compressive strength of soil; Determination of shear parameters by Tri-axial test; Determination of consolidation properties of soils.

Lecture Schedule

1. Formation of soils - Soil types in India,
2. Soil as a 3 phase system - void ratio - specific gravity - dry density - porosity -
3. Water content Saturated unit weight - submerged unit weight - degree of saturation
4. Water content Saturated unit weight - submerged unit weight - degree of saturation
5. Soil Structure: single grained, honey combed, flocculated and dispersed structure and their effects on the basic soil properties.
6. Determination of water content by oven drying – Specific gravity using pycnometer and specific gravity bottle - Grain size analysis by sieve analysis
7. hydrometer analysis and pipette analysis -
8. Atterberg limits and indices –
9. Visual identification by simple field tests – Field density by core cutter, sand replacement and wax coating methods
10. Necessity of soil classification - Principles of classification - I.S. classification
11. Plasticity charts – Group index

12. Modes of occurrence of water in soil – adsorbed and capillary water types-Total stress - Effective stress – Pore pressure - Pressure diagrams
13. Modes of occurrence of water in soil – adsorbed and capillary water types-Total stress - Effective stress – Pore pressure - Pressure diagrams
14. Permeability of soil - Darcy's law - Factors affecting permeability – Laboratorydetermination
15. Stratified soils : average permeability
16. Shear strength - definition - Mohr's strength and stress circles
17. Shear strength - definition - Mohr's strength and stress circles
18. origin of planes - Mohr's envelope - Mohr- Coulomb strength theory
19. Direct shear test – introduction to triaxial shear test-
20. Mid Examination
21. Measurement of pore pressure. Total and effective stress strength parameters
22. UCC test - Vane shear tests
23. Choice of test conditions for field problems.
24. Consolidation - Definition –Spring analogy for primary consolidation - Terzaghi's theory of one dimensional consolidation
25. Concepts of coefficient of compressibility - Coefficient of volume change and compression index
26. Laboratory consolidation test. e-log p curves – pre-consolidation pressure
27. Time rate of consolidation - difference between consolidation and compaction
28. Compaction- definition and objectives of compaction – Standard and Modified Proctor tests
29. Concept of OMC and maximum dry density - Zero air voids line. Factors influencing compaction - Effect of compaction on soil properties
30. Field compaction methods - Proctor needle for field control.
31. Earth pressure -earth pressure at rest - Active and passive earth pressure for cohesionless and cohesive soils
32. Rankine's and Coulomb's theories -
33. Point of application of earth pressurefor cases of with and without surcharge in cohesionless and cohesive soils
34. Culmann's and Rebhan's graphical construction for active earth pressure-
35. Stability of slopes -slope failure, base failure and toe failure - Swedish circle method – $\Phi = 0$ analysis and $c = 0$ analysis
36. Friction circle method - Taylor's stability number –Stabilitycharts.

Practical Schedule

1. Determination of water content of soil
2. Determination of specific gravity of soil
3. Determination of field density of soil by core cutter method
4. Determination of field density by sand replacement method
5. Grain size analysis by sieving (Dry sieve analysis)
6. Grain size analysis by hydrometer method
7. Determination of liquid limit by Casagrande's method
8. Determination of liquid limit by cone penetrometer and plastic limit
9. Determination of shrinkage limit
10. Determination of permeability by constant head method
11. Determination of permeability by variable head method
12. Determination of compaction properties by standard proctor test
13. Determination of shear parameters by Direct shear test
14. Determination of unconfined compressive strength of soil
15. Determination of shear parameters by Tri-axial test
16. Determination of consolidation properties of soils.
17. Determination of consolidation properties of soils.
18. Final Practical Examination

Text Books

- Arora K. R., *Soil Mechanics & Foundation Engineering*, Standard Publications, 1987.
Murthy V. N. S., *Soil Mechanics & Foundation Engineering*, DhanpatRai, 1996
Punmia B. C., *Soil Mechanics & Foundations*, Laxmi Publications, 1988

Reference Books

- Cudoto, *Geotechnical Engineering Principles and Practices*, Pearson Education, 2007
GopalRanjan&Rao A. S. R., *Basic & Applied Soil Mechanics*, New Age International Publishers, 2000
Khan I.H., *Text Book of Geotechnical Engineering*, Prentice Hall of India
Terzaghi K. & Peck R.B., *Soil Mechanics in Engineering Practice*, John Wiley & Sons, US, 1967.
Venkatramiah C., *Geotechnical Engineering*, New Age International Publishers, 2006

Lwre. 2206 Soil and Water Conservation Engineering 3(2+1)

Objective

The main objective is to study the causes of erosion, how to reduce erosion and other forms of soil degradation by using land in accordance with its capabilities. Proper application of different soil and water conservation measures to restore the productivity of the soil where it has been damaged. It is also helps to combine sound methods of soil management with other methods and inputs of modern agriculture to obtain satisfactory production on a sustained basis.

Theory

Module I (9 Hours)

Soil erosion - Introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion. Water erosion - Mechanics and forms - splash, sheet, rill, gully, ravine and stream bank erosion. Gullies - Classification, stages of development.

Module II (9 Hours)

Soil loss estimation – Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity - estimation by $KE > 25$ and EI_{30} methods. Soil erodibility - topography, crop management and conservation practice factors. Measurement of soil erosion - Runoff plots, soil samplers.

Module III (10 Hours)

Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching. Engineering measures – Bunds and terraces. Bunds - contour and graded bunds - design and surplussing arrangements. Terraces - level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stonewall and trenching. Gully and ravine reclamation - principles of gully control - vegetative measures, temporary structures and diversion drains. Grassed waterways and design. Use of Geotextiles in soil and water conservation

Module IV (8 Hours)

Wind erosion- Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes. Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks.

Lecture Schedule

- 1&2. Introduction, causes and types - geological and accelerated erosion and agents causing erosion
- 3&4 Water erosion - Mechanics and forms - splash, sheet, rill, gully, ravine and stream bank erosion.
- 5&6 Factors affecting and effects of erosion,
- 7&8. Gullies - Classification, stages of development.
- 9&10. Soil loss estimation – Universal soil loss equation (USLE) and modified USLE.
- 11 &12. Rainfall erosivity - estimation by $KE > 25$ and EI_{30} methods.
- 13&14 Soil erodibility - topography, crop management and conservation practice factors. Measurement of soil erosion - Runoff plots, soil samplers.
- 15&16 Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching.
- 17-19 Engineering measures – Bunds and terraces. Bunds - contour and graded bunds - design and surplussing arrangements
20. Mid Examination
- 21-24 Terraces - level and graded broad base terraces, bench terraces - planning, design and layout procedure
- 25 contour stonewall and trenching
- 26&27 Gully and ravine reclamation - principles of gully control - vegetative measures, temporary structures and diversion drains.
- 28&29 Grassed waterways and design.
30. Use of Geotextiles in soil and water conservation
31. Use of Geotextiles in soil and water conservation
- 32-34 Wind erosion- Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes.
35. Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks.
36. Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks.

Practical

1. Study of different types and forms of water erosion.
2. Exercises on computation of rainfall erosivity index. Computation of soil erodibility index in soil loss estimation.
3. Determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE and MUSLE. Exercises on soil loss estimation/measuring techniques.
4. Study of rainfall simulator for erosion assessment.
5. Estimation of sediment rate using Coshocton wheel sampler and multi-slot divisor.
6. Determination of sediment concentration through oven dry method.
7. Design and layout of contour bunds.
8. Design and layout of contour bunds.
9. Design and layout of graded bunds.
10. Design and layout of graded bunds.
11. Design and layout of broad base terraces.
12. Design and layout of broad base terraces.
13. Design and layout of bench terraces.
14. Design of vegetative waterways.
15. Exercises on rate of sedimentation and storage loss in tanks.
16. Computation of soil loss by wind erosion. Design of shelterbelts and wind breaks for wind erosion control.
17. Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures.
18. Final Practical Examination

Suggested Readings

- Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service, New Delhi.
- Mal, B.C. 2014. Introduction to Soil and Water Conservation Engineering. 2014. Kalyani Publishers.
- Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
- Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
- Norman Hudson. 1985. Soil Conservation. Cornell University Press, Ithaca, New York, USA.
- Frevert, R.K., G.O. Schwab, T.W. Edminster and K.K. Barnes. 2009. Soil and Water Conservation Engineering, 4th Edition, John Wiley and Sons, New York.
- Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.

Lwre. 3107 Water Harvesting and Soil Conservation Structures 3(2+1)

Objective

- To familiarise the water harvesting techniques based on source, storage and use and also introduce the soil and water conservation structures.
- To impart awareness on the design requirements, planning for design, design procedures such as hydrologic, hydraulic and structural design and stability analysis of different structures.

Theory

Module I

(6 Hours)

Water harvesting -principles, importance and issues. Water harvesting techniques - classification based on source, storage and use. Runoff harvesting – short-term and long-term techniques.

Module II

(6 Hours)

Structures Farm pond - components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction. Percolation pond - site selection, design and construction details. Design considerations of *nala* bunds.

Module III

(10 Hours)

Soil erosion control structures - introduction, classification and functional requirements. Permanent structures for soil conservation and gully control - check dams, drop, chute and drop inlet spillways - design requirements, planning for design, design procedures - hydrologic, hydraulic and structural design and stability analysis. Drop spillway - applicability, types - straight drop, box-type inlet spillways - description, functional use, advantages and disadvantages, straight apron and stilling basin outlet, structural components and functions.

Module IV

(8 Hours)

Hydraulic jump and its application. Loads on head wall, variables affecting equivalent fluid pressure, triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.

Module V

(6 Hours)

Chute spillway - description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations. Drop inlet spillway - description, functional use and design criteria. Design of Diversions.

Practical

Study of different types of farm ponds. Computation of storage capacity of embankment type of farm ponds. Design of dugout farm ponds. Design of percolation pond and *nala* bunds. Exercise on hydraulic jump. Exercise on energy dissipation in water flow. Hydrologic, hydraulic and structural design of drop spillway and stability analysis. Design of SAF stilling basins in chute spillway. Hydrologic, hydraulic and structural design of drop inlet spillway. Design of small earthen embankment structures. Practice on software for design of soil and water conservation structures. Field visit to watershed project areas treated with soil and water conservation measures / structures.

Lecture schedule

1. Water harvesting -principles, importance and issues.
2. Water harvesting techniques - classification based on source, storage and use.
3. Runoff harvesting – short-term techniques.
4. Runoff harvesting –long-term techniques
5. Structures: Farm pond –general description and its components, different types, site selection.
6. Farm pond- design criteria and storage capacity of embankment type farm ponds
7. Mechanical and emergency spillways-cost estimation and construction.
8. Percolation pond - site selection, design and construction details.
9. Percolation pond - Design problems
10. Design considerations of *nala* bunds.
11. Soil erosion control structures - introduction, classification and functional requirements.
12. Permanent structures for soil conservation and gully control –different types
13. Check dams, - design requirements, planning for design, design procedures
14. Check dams, - hydrologic, hydraulic and structural design and stability analysis.
15. Drop spillways- design requirements, planning for design, design procedures
16. Drop spillways- hydrologic, hydraulic and structural design and stability analysis.
17. Chute spillways- design requirements, planning for design, design procedures
18. Chute spillways- hydrologic, hydraulic and structural design and stability analysis.
19. Drop inlet spillways - design requirements, planning for design, design procedures
20. Mid Examination
21. Drop inlet spillways - hydrologic, hydraulic and structural design and stability analysis.
22. Drop spillway - applicability, types - advantages and disadvantages,
23. Straight apron and stilling basin outlet, structural components and functions.
24. Hydraulic jump and its application, type of hydraulic jump.
25. Hydraulic jump and its application, type of hydraulic jump,
26. Energy dissipation due to hydraulic jump, jump efficiency, relative loss of energy
27. Straight drop spillways, box-type inlet spillways - description, functional use,
28. Straight drop spillways, box-type inlet spillways - description, functional use,
29. Drop spillway structural design- Loads on head wall, Variables affecting equivalent fluid pressure
30. Drop spillway structural design- Loads on head wall, Variables affecting equivalent fluid pressure
31. Triangular load diagram for various flow conditions, creep line theory
32. Uplift pressure estimation, safety against sliding,
33. Overturning, crushing and tension. Chute spillway - description, components,

34. Hydraulic design, Energy dissipaters. Design criteria of Saint Antony Falls (SAF) stilling basin and its limitations.
35. Drop inlet spillway - description, functional use and design criteria
36. Diversions structures – general description.Design ofDiversions

Practical

1. Study of different types of farm ponds.
2. Computation of storage capacity of embankment type of farm ponds.
3. Design of dugout farm ponds.
4. Design of percolation pond and *nala* bunds.
5. Exercise on hydraulic jump.
6. Problems
7. Exercise on energy dissipation in water flow.
8. Hydrologic, hydraulic and structural design of drop spillway
9. Stability analysis of design of drop spillway.
10. Design of SAF stilling basins in chute spillway.
11. Stability analysis of design of chute spillway
12. Hydrologic, hydraulic and structural design of drop inlet spillway.
13. Design of small earthen embankment structures.
14. Design of small earthen embankment structures.
15. Practice on software for design of soil and water conservation structures I.
16. Practice on software for design of soil and water conservation structures II.
17. Field visit to watershed project areas treated with soil and water conservation measures structures.
18. Final Practical Examination

Suggested Readings

- Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II.4thEdition, Jain Brothers, New Delhi.
- Murthy, V.V.N. 2002.Land and Water Management Engineering. 4th Edition, KalyaniPublishers, New Delhi.
- Samra, J.S., V.N. Sharda and A.K. Sikka. 2002. Water Harvesting and Recycling: Indian Experiences. CSWCR&TI, Dehradun, Allied Printers, Dehradun.
- Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1993. Soil and Water Conservation Engineering.4th Edition, John Wiley and Sons Inc. New York.
- Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Studer Rima Mekdaschi and HanspeterLiniger. 2013. Water Harvesting - Guidelines to Good Practice. Centre for Development and Environment, University of Bern, Switzerland.
- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
- Theib Y. Oweis, Dieter Prinz and Ahmed Y. Hachum. 2012. Rainwater Harvesting for Agriculture in the Dry Areas. CRC Press, Taylor and Francis Group, London.

Lwre. 3208 Watershed Planning and Management 2(1+1)

Objectives

- The student will get a comprehensive idea about watershed management.
- The student will be capable of planning and execution of watershed management projects.

Theory

Module I

(5 Hours)

Watershed - introduction and characteristics. Watershed development - problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, land use practices and socio-economic factors. Watershed management - concept, objectives, factors affecting, watershed planning based on land capability classes, hydrologic data for watershed planning, watershed codification, delineation and prioritization of watersheds – sediment yield index. Water budgeting in a watershed.

Module II

(8 Hours)

Management measures - rainwater conservation technologies - *in-situ* and *ex-situ* storage, water harvesting and recycling. Dry farming techniques - inter-terrace and inter-bund land management. Integrated watershed management - concept, components, arable lands - agriculture and horticulture, non-arable lands - forestry, fishery and animal husbandry. Effect of cropping systems, land management and cultural practices on watershed hydrology. Watershed programme - execution, follow-up practices, maintenance, monitoring and evaluation. Participatory watershed management - role of watershed associations, user groups and self-help groups. People's participation in watershed management.

Module III

(5 Hours)

Estimate preparation for watershed projects- Detailed estimate-Analysis of rates-Abstract of estimate. Planning and formulation of project proposal for watershed management programme including cost-benefit analysis. Preparation of detailed project report (DPR) for watershed projects.

Practical

Exercises on delineation of watersheds using toposheets. Surveying and preparation of watershed map. Quantitative analysis of watershed characteristics and parameters. Watershed investigations for planning and development. Analysis of hydrologic data for planning watershed management. Water budgeting of watersheds. Prioritization of watersheds based on sediment yield index. Study of functional requirement of watershed development structures. Study of watershed management technologies. Practice on softwares for analysis of hydrologic parameters of watershed. Study of role of various functionaries in watershed development programmes. Estimate preparation for watershed projects- Detailed estimate-Analysis of rates-Abstract of estimate. Study of preparation of detailed project report (DPR) for watershed projects. Techno-economic viability analysis of watershed projects. Visit to watershed development project areas.

Lecture Schedule

1. Watershed – introduction and characteristics.
2. Watershed development - problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors.
3. Watershed management - concept, objectives, factors affecting.
4. Watershed planning based on land capability classes, hydrologic data for watershed planning,
5. Watershed delineation, coding of watershed, prioritization of watersheds – sediment yield index. Water budgeting in a watershed.
6. Management measures - rainwater conservation technologies - *in-situ* and *ex-situ* storage,
7. Water harvesting and recycling.
8. Dry farming techniques - inter-terrace and inter-bund land management.
9. Integrated watershed management - concept, components, arable lands - agriculture and horticulture, non-arable lands - forestry, fishery and animal husbandry.
10. Mid Examination
11. Effect of cropping systems, land management and cultural practices on watershed hydrology.

12. Watershed programme - execution, follow-up practices, maintenance, monitoring and evaluation.
13. People's participation in watershed management.
14. Participatory watershed management - role of watershed associations, user groups and self-help groups.
15. Estimate preparation for watershed projects- Detailed estimate-Analysis of rates-Abstract of estimate.
16. Planning and formulation of project proposal for watershed management programme including cost-benefit analysis.
17. Preparation of detailed project report (DPR) for watershed projects
18. Preparation of detailed project report (DPR) for watershed projects

Practical Schedule

1. Exercises on delineation of watersheds using toposheets.
2. Surveying and preparation of watershed map.
3. Quantitative analysis of watershed characteristics and parameters.
4. Watershed investigations for planning and development.
5. Analysis of hydrologic data for planning watershed management.
6. Water budgeting of watersheds.
7. Prioritization of watersheds based on sediment yield index.
8. Study of functional requirement of watershed development structures.
9. Study of watershed management technologies.
10. Practice on softwares for analysis of hydrologic parameters of watershed.
11. Study of role of various functionaries in watershed development programmes.
12. Estimate preparation for watershed projects-
13. Detailed estimate-
14. Analysis of rates-
15. Abstract of estimate.
16. Study of preparation of detailed project report (DPR) for watershed projects.
17. Visit to watershed development project areas.
18. Final Practical Examination

Suggested Readings

- Ghanshyam Das. 2008. Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
- Katyal, J.C., R.P. Singh, Shrinivas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra. 1995. Field Manual on Watershed Management. CRIDA, Hyderabad.
- Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi.
- Sharda, V.N., A.K. Sikka and G.P. Juyal. 2006. Participatory Integrated Watershed Management: A Field Manual. Central Soil and Water Conservation Research and Training Institute, Dehradun.
- Singh, G.D. and T.C. Poonia. 2003. Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.
- Singh, R.V. 2000. Watershed Planning and Management. Yash Publishing House, Bikaner.
- Singh, P.K. 2000. Watershed Management: Design and Practices. E-media Publications, Udaipur.
- Tideman, E.M. 1999. Watershed Management: Guidelines for Indian Conditions. Omega Scientific Publishers, New Delhi.

Lwre. 3209 Remote Sensing and GIS Applications 2(1+1)

Objective

- To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing, GIS and GPS technologies.
- To acquire skills in storing, managing digital data for planning and development.

Theory

Module I (6 Hours)

Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water; spectral signatures; different types of sensors and platforms; contrast ratio and possible causes of low contrast.

Module II (3 Hours)

Aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap; stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation- interpretation elements; Introduction to photogrammetry.

Module III (4 Hours)

satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices; Introduction to microwave remote sensing.

Module IV (5 Hours)

GIS and basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties, Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS. Introduction to GPS: History, Transit, Timation, NAVSTAR GPS, GLONASS, GALILEO, IRNSS; GPS design objectives and details of segments space, control and user. Application of remote sensing and GIS for the management of land and water resources.

Practical

Familiarization with remote sensing and GIS hardware; use of software for image interpretation; interpretation of aerial photographs and satellite imagery; basic GIS operations such as image display; study of various features of GIS software package; scanning, digitization of maps and data editing; data base query and map algebra. GIS supported case studies in water resources management.

Lecture Schedule

1. Basic component of remote sensing (RS), advantages and limitations of RS.
2. Possible use of RS techniques in assessment and monitoring of land and water resources
3. Electromagnetic spectrum and energy interactions in the atmosphere and with the Earth's surface
4. Major atmospheric windows; principal applications of different wavelength regions

5. Typical spectral reflectance curve for vegetation, soil and water; Spectral signatures.
6. Different types of sensors and platforms. Contrast ratio and possible causes of low contrast
7. Aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap
8. Stereoscopic vision, requirements of stereoscopic photographs, Air-photo interpretation-interpretation elements
9. Photogrammetry- measurements on a single vertical aerial photograph.
10. Mid Examination
11. Satellite remote sensing, multispectral scanner, whiskbroom and push-broom scanner.
12. Different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction.
13. Image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices;
14. Principles and physics of microwave remote sensing, Radar principle, radar image properties, polarimetry and SAR.
15. GIS and basic components, different sources of spatial data, basic spatial entities, major components of spatial data,
16. Basic classes of map projections and their properties, Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS.
17. Introduction to GPS: History, Transit, Timation, NAVSTAR GPS, GLONASS, GALILEO, IRNSS; GPS design objectives and details of segments space, control and user, Application of remote sensing and GIS for the management of land and water resources.
18. Introduction to GPS: History, Transit, Timation, NAVSTAR GPS, GLONASS, GALILEO, IRNSS; GPS design objectives and details of segments space, control and user, Application of remote sensing and GIS for the management of land and water resources.

Practical Schedule

1. Interpretation of aerial photograph
2. Photogrammetry
3. Introduction to image processing software
4. Image pre processing technique - contrast enhancement
5. Image pre processing technique - spatial enhancement
6. Image classification - unsupervised
7. Image classification - supervised
8. Multiband operation
9. Introduction to GIS software
10. Coordinate systems
11. Georeferencing
12. Creation of point and line map
13. Creation of polygon map
14. Creation of polygon map
15. spatial data management, attribute data handling
16. Digital elevation model (DEM)
17. Geostatistical analysis. RS and GIS application in Agricultural Engineering.
18. Final Practical Examination

Suggested Readings

- Chang, K.T. 2014. Introduction to Geographic Information System, McGraw Hill
- George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
- Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.

Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.

Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.

Shultz, G.A. and E.T. Engman. 2000. Remote Sensing in Hydrology and Water Management. Springer, New York

Land and Water Resources and Conservation Engineering-Electives

Ellw.4201 Floods and Control Measures 3(2+1)

Objectives

- To familiarize the students with the relevance of different flood control measures.
- To impart the knowledge about planning of flood control projects and their economics.

Theory

Module I

(12 Hours)

Floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood, flood estimation - methods of estimation; estimation of flood peak - rational method, empirical methods, unit hydrograph method. Statistics in hydrology, flood frequency methods - log normal, Gumbel's extreme value, log-Pearson type-III distribution; depth-area-duration analysis. Flood forecasting. Flood routing - channel routing, Muskingum method, reservoir routing, modified Pul's method. Flood control - history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement.

Module II

(10 Hours)

Gully erosion and its control structures - design and implementation. Ravine control measures. River training works, planning of flood control projects and their economics. Earthen embankments - functions, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type, foundation requirements, grouting, seepage through dams.

Module III

(8 Hours)

Flow net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes. Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc., stability of slopes - analysis of failure by different methods.

Module IV

(6 Hours)

Subsurface dams - site selection and constructional features. Check dam - Small earthen embankments - types and design criteria. Subsurface dams - site selection and constructional features.

Practical

Determination of flood stage-discharge relationship in a watershed. Determination of flood peak-area relationships. Determination of frequency distribution functions for extreme flood values using Gumbel's method. Determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution. Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution. Determination of probable maximum flood, standard project flood and spillway design flood. Design of levees for flood control. Design of jetties. Study of vegetative and structural measures for gully stabilization. Design of gully/ravine control structures and cost estimation. Designing, planning and cost-benefit analysis of a flood control project. Study of different types, materials and design considerations of earthen dams. Determination of the position of phreatic line in earth dams for various conditions, stability analysis of earthen dams against head water pressure, foundation shear, sudden draw down condition etc. Stability of slopes of earth dams by friction circle and other methods. Construction of flow net for isotropic and anisotropic media. Computation of seepage by different

methods. Determination of settlement of earth dam. Input-output-storage relationships by reservoir routing. Visit to sites of earthen dam and water harvesting structures.

Lecture schedule

1. Floods - causes of occurrence, flood classification
2. Probable maximum flood, standard project flood
3. Probable maximum flood, standard project flood
4. Design flood, flood estimation - methods of estimation; estimation of flood peak - rational method, empirical methods, unit hydrograph method
5. Design flood, flood estimation - methods of estimation; estimation of flood peak - rational method, empirical methods, unit hydrograph method
6. Statistics in hydrology, flood frequency methods - log normal, Gumbel's extreme value, log-Pearson type-III distribution
7. Statistics in hydrology, flood frequency methods - log normal, Gumbel's extreme value, log-Pearson type-III distribution
8. Statistics in hydrology, flood frequency methods - log normal, Gumbel's extreme value, log-Pearson type-III distribution
9. Depth-area-duration analysis
10. Depth-area-duration analysis
11. Flood forecasting. Flood routing - channel routing, Muskingum method, reservoir routing, modified Pul's method
12. Flood forecasting. Flood routing - channel routing, Muskingum method, reservoir routing, modified Pul's method
13. Flood control - history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement
14. Flood control - history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement
15. Gully erosion and its control structures - design and implementation
16. Gully erosion and its control structures - design and implementation
17. Ravine control measures
18. Ravine control measures
19. River training works, planning of flood control projects and their economics
20. Mid Examination
21. River training works, planning of flood control projects and their economics
22. Earthen embankments – functions, advantages and disadvantages
23. Classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type
24. Classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type
25. Foundation requirements, grouting, seepage through dams
26. Foundation requirements, grouting, seepage through dams
27. Flow net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes
28. Flow net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes
29. Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc
30. Design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc
31. Stability of slopes - analysis of failure by different methods
32. Stability of slopes - analysis of failure by different methods
33. Subsurface dams - site selection and constructional features
34. Subsurface dams - site selection and constructional features

35. Check dam - Small earthen embankments - types and design criteria
36. Check dam - Small earthen embankments - types and design criteria

Practical Schedule

1. Determination of flood stage-discharge relationship in a watershed
2. Determination of flood peak-area relationships
3. Determination of frequency distribution functions for extreme flood values using Gumbel's method
4. Determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution
5. Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution
6. Determination of probable maximum flood, standard project flood and spillway design flood
7. Design of levees for flood control
8. Design of jetties
9. Study of vegetative and structural measures for gully stabilization
10. Design of gully/ravine control structures and cost estimation
11. Designing, planning and cost-benefit analysis of a flood control project
12. Study of different types, materials and design considerations of earthen dams.
13. Determination of the position of phreatic line in earth dams for various conditions
14. Stability analysis of earthen dams against head water pressure, foundation shear, sudden draw down condition etc.
15. Stability of slopes of earth dams by friction circle and other methods.
16. Construction of flow net for isotropic and anisotropic media.
17. Visit to sites of earthen dam and water harvesting structures.
18. Final Practical Examination

Suggested Readings

- Arora, K.R. 2014. Soil Mechanics and Foundation Engineering (Geotechnical Engineering). Standard Publishers Distributors, Delhi.
- Bureau of Reclamation. 1987. Design of Small Dams. US Department of Interior, Washington DC, USA.
- Garg, S.K. 2014. Soil Mechanics and Foundation Engineering. Khanna Publishers Pvt. Ltd., New Delhi.
- Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
- Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
- Mutreja, K.N. 1990. Applied Hydrology. Tata McGraw-Hill Publishing Co., New York, Delhi.
- Stephens Tim. 2010. Manual on Small Earth Dams - A Guide to Siting, Design and Construction. Food and Agriculture Organization of the United Nations, Rome.
- Subramanya, K. 2008. Engineering Hydrology. 3rd Edition, Tata McGraw-Hill Publishing Co., New Delhi.
- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.

Ellw.4202 Wasteland Development 3(2+1)

Objectives

- To familiarize the students with the relevance of wasteland development and its socio economic perspectives.
- To impart the knowledge about the planning and design of engineering measures for reclamation of wasteland.

Theory

Module I (10 Hours)

Land degradation – concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands. Wastelands - factors causing, classification and mapping of wastelands, planning of wastelands development - constraints, agro-climatic conditions, development options, contingency plans. Conservation structures - gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods.

Module II (10 Hours)

Afforestation - agro-horti-forestry-silvipasture methods, forage and fuel crops - socioeconomic constraints. Shifting cultivation, optimal land use options. Wasteland development – hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands.

Module III (8 Hours)

Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management. Micro-irrigation in wastelands development. Sustainable wasteland development - drought situations, socio-economic perspectives.

Module IV (8 Hours)

Government policies. Participatory approach. Preparation of proposal for wasteland development and benefit-cost analysis.

Practical

Mapping and classification of wastelands. Identification of factors causing wastelands. Estimation of vegetation density and classification. Planning and design of engineering measures for reclamation of wastelands. Design and estimation of different soil and water conservation structures under arid, semiarid and humid conditions. Planning and design of micro-irrigation in wasteland development. Cost estimation of the above measures / structures. Visit to wasteland development project sites.

Lecture schedule

1. Land degradation – concept
2. Classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands
3. Classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands
4. Wastelands - factors causing, classification and mapping of wastelands
5. Wastelands - factors causing, classification and mapping of wastelands
6. Planning of wastelands development - constraints, agro-climatic conditions, development options, contingency plans.
7. Planning of wastelands development - constraints, agro-climatic conditions, development options, contingency plans.
8. Conservation structures - gully stabilization

9. Conservation structures - gully stabilization
10. Conservation structures - ravine rehabilitation
11. Conservation structures - ravine rehabilitation
12. Conservation structures - sand dune stabilization
13. Conservation structures - sand dune stabilization
14. Conservation structures - water harvesting and recycling methods
15. Conservation structures - water harvesting and recycling methods
16. Afforestation - agro-horti-forestry-silvipasture methods, forage and fuel crops - socioeconomic constraints
17. Afforestation - agro-horti-forestry-silvipasture methods, forage and fuel crops - socioeconomic constraints
18. Shifting cultivation, optimal land use options
19. Shifting cultivation, optimal land use options
20. Mid Examination
21. Wasteland development - hills
22. Wasteland development - semi-arid regions
23. Wasteland development - coastal areas
24. Wasteland development - water scarce areas
25. Wasteland development - reclamation of waterlogged and salt-affected lands
26. Wasteland development - reclamation of waterlogged and salt-affected lands
27. Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management
28. Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management
29. Micro-irrigation in wastelands development
30. Micro-irrigation in wastelands development
31. Sustainable wasteland development - drought situations, socio-economic perspectives
32. Sustainable wasteland development - drought situations, socio-economic perspectives
33. Government policies, Participatory approach
34. Preparation of proposal for wasteland development
35. Preparation of proposal for wasteland development
36. benefit-cost analysis

Practical schedule

1. Mapping and classification of wastelands
2. Mapping and classification of wastelands
3. Identification of factors causing wastelands
4. Identification of factors causing wastelands
5. Estimation of vegetation density and classification
6. Estimation of vegetation density and classification
7. Planning and design of engineering measures for reclamation of wastelands
8. Planning and design of engineering measures for reclamation of wastelands
9. Design and estimation of different soil and water conservation structures under arid conditions
10. Design and estimation of different soil and water conservation structures under arid conditions
11. Design and estimation of different soil and water conservation structures under semiarid conditions
12. Design and estimation of different soil and water conservation structures under humid conditions
13. Planning and design of micro-irrigation in wasteland development
14. Planning and design of micro-irrigation in wasteland development
15. Cost estimation of the above measures / structures

16. Cost estimation of the above measures / structures
17. Visit to wasteland development project sites
18. Final Practical Examination

Suggested Readings

- Abrol, I.P., and V.V. Dhruvanarayana. 1998. Technologies for Wasteland Development. ICAR, New Delhi.
- Ambast, S.K., S.K. Gupta and Gurcharan Singh (Eds.) 2007. Agricultural Land Drainage - Reclamation of Waterlogged Saline Lands. Central Soil Salinity Research Institute, Karnal, Haryana.
- Hridai Ram Yadav. 2013. Management of Wastelands. Concept Publishing Company. New Delhi.
- Karthikeyan, C., K. Thangaraja, C. Cinthia Fernandez and K. Chandrakandon. 2009. Dryland Agriculture and Wasteland Management. Atlantic Publishers and Distributors Pvt. Ltd., New Delhi.
- Rattan Lal and B.A. Stewart (Ed.). 2015. Soil Management of Smallholder Agriculture. Volume 21 of Advances in Soil Science. CRC Press, Taylor and Francis Group, Florida, USA.
- Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management. Springer Heidelberg, New York.
- Swaminathan, M.S. 2010. Science and Integrated Rural Development. Concept Publishing Company (P) Ltd., Delhi.
- The Energy and Resources Institute. 2003. Looking Back to Think Ahead-Green India 2047. Growth with Resource Enhancement of Environment and Nature. New Delhi.
- Virmani, S.M. (Ed.). 2010. Degraded and Wastelands of India: Status and Spatial Distribution. ICAR, New Delhi.

Ellw.4203 Information Technology for Land and Water Management 3(2+1)

Objective

- To gain knowledge on the application of IT for the sustainable and productive use of land and water especially from the point of view of agriculture.

Theory

Module I

(10 Hours)

Concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. Existing system of information generation and organizations involved in the field of land and water management. Application and production of multimedia. Internet application tools and web technology.

Module II

(10 Hours)

Networking system of information. Problems and prospects of new information and communication technology. Development of database concept for effective natural resources management.

Module III

(8 Hours)

Application of remote sensing, geographic information system (GIS) and GPS. Rational data base management system. Object oriented approaches. Information system, decision support systems and expert systems.

Module IV

(8 Hours)

Agricultural information management systems - use of mathematical models and programmes. Application of decision support systems, multi sensor data loggers and overview of software packages in natural resource management. Video-conferencing of scientific information.

Practical

Multimedia production. Internet applications: E-mail, voice mail, web tools and technologies. Handling and maintenance of new information technologies and exploiting their potentials. Exercises on database management using database and spreadsheet programmes. Usage of remote sensing, GIS and GPS survey in information generation and processing. Exercises on running computer software packages dealing with water balance, crop production, land development, land and water allocation, watershed analysis etc. Exercises on simple decision support and expert systems for management of natural resources. Multimedia production using different softwares. Exercises on development of information system on selected theme(s). Video-conferencing of scientific information.

Lecture Schedule

1. Concept of Information Technology (IT) and its application potential
2. Concept of Information Technology (IT) and its application potential
3. Role of IT in natural resources management.
4. Role of IT in natural resources management.
5. Existing system of information generation and organizations involved in the field of land and water management.
6. Existing system of information generation and organizations involved in the field of land and water management.
7. Application and production of multimedia.
8. Application and production of multimedia.
9. Internet application tools and web technology.
10. Internet application tools and web technology.
11. Networking system of information.
12. Networking system of information.
13. Problems and prospects of new information and communication technology.
14. Problems and prospects of new information and communication technology.
15. Development of database concept for effective natural resources management.
16. Development of database concept for effective natural resources management.
17. Introduction to remote sensing
18. Introduction to remote sensing
19. Application of remote sensing in land and water management.
20. Mid Examination
21. Application of remote sensing in land and water management.
22. Introduction to GIS
23. Introduction to GIS
24. Introduction to GPS technology
25. Introduction to GPS technology
26. Principles of rational data base management system.
27. Principles of rational data base management system.
28. Object oriented approaches in DBMS. Information system
29. Object oriented approaches in DBMS. Information system
30. Decision support systems and expert systems.
31. Agricultural information management systems
32. Agricultural information management systems

33. Use of mathematical models and programmes for LWR management.
34. Use of mathematical models and programmes for LWR management.
35. Application of decision support systems, multi sensor data loggers and overview of software packages in natural resource management. Video-conferencing of scientific information.
36. Application of decision support systems, multi sensor data loggers and overview of software packages in natural resource management. Video-conferencing of scientific information.

Practical

1. Multimedia production.
2. Internet applications: E-mail, voice mail, web tools and technologies.
3. Handling and maintenance of new information technologies and exploiting their potentials.
4. Exercises on database management using database and spreadsheet programmes.
5. Use of Remote Sensing in information generation and processing
6. Use of GIS in information generation and processing
7. Use of GPS survey in information generation and processing.
8. Use of GPS survey in information generation and processing.
9. Exercises on water balance with software package
10. Exercise on crop production with software package
11. Exercise on crop production with software package
12. Exercise on land development, land and water allocation with software package,
13. Exercise on watershed analysis with software package.
14. Exercises on simple decision support and expert systems for management of natural resources.
15. Multimedia production using different softwares.
16. Exercises on development of information system on selected theme(s).
17. Video-conferencing of scientific information.
18. Final Practical Examination.

Suggested Readings

- Climate-Smart Agriculture – Source Book. 2013. Food and Agriculture Organization, Rome.
- Daniel P. Loucks and Eelco van Beek. 2005. Water Resources Systems Planning and Management - An Introduction to Methods, Models and Applications. UNESCO, Paris.
- Dipak De and Basavaprabhu Jirli (Eds.). 2010. Communication Support for Sustainable Development. Ganga Kaveri Publishing House, Varanasi – 221001.
- FAO. 1998. Land and Water Resources Information Systems. FAO Land and Water Bulletin 7, Rome.
- FulingBian and YichunXie (Eds.). 2015. Geo-Informatics in Resource Management and Sustainable Ecosystem. Springer, New York.
- ICFAI Business School (IBS). 2012. Information Technology and Systems. IBS Centre for Management Research, Hyderabad.
- Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management. Environmental Science. Springer, New York.
- Sarvanan. R. 2011. Information and Communication Technology for Agriculture and Rural Development. New India Publishing Agency, New Delhi.
- Soam, S.K., P.D. Sreekanth and N.H. Rao (Eds.). 2013. Geospatial Technologies for Natural Resources Management. New India Publishing Agency, Delhi.

Ellw.4204 Precision Farming Techniques for Protected Cultivation 3(2+1)

Objective

1. To familiarize the students with the relevance and scope of precision farming and protected cultivation.
2. To impart knowledge about the various modern precision farming techniques and their application in protected cultivation.

Theory

Module I

(10 Hours)

Protected cultivation: Introduction, History, origin, development, National and International Scenario, components of green house, perspective, Types of green houses, polyhouses /shed nets, Cladding materials, Plant environment interactions – principles of limiting factors, solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment, Design and construction of green houses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment, Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fan-pad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care etc.

Module II

(10 Hours)

Greenhouse heating – necessity, components, methods, design of heating system. Root media – types – soil and soil less media, composition, estimation, preparation and disinfection, bed preparation. Planting techniques in green house cultivation. Irrigation in greenhouse and net house – Water quality, types of irrigation system, components, design, installation and material requirement. Fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement. Maintenance of irrigation and fogging systems.

Module III

(8 Hours)

Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, principles of selection of proper application of fertilizers, fertilizer scheduling, rate of application of fertilizers, methods, automated fertilizer application. Greenhouse climate measurement, control and management.

Module IV

(8 Hours)

Insect and disease management in greenhouse and net houses Selection of crops for greenhouse cultivation, major crops in greenhouse – irrigation requirement, fertilizer management, cultivation, harvesting and post harvest techniques; Economic analysis.

Practical

Estimation of material requirement for construction of greenhouse ; Determination of fertilization schedule and rate of application for various crops; Estimation of material requirement for preparation of root media; Root media preparation, bed preparation and disinfections; Study of different planting techniques ; Design and installation of irrigation system; Design and installation of fogging system ; Greenhouse heating; Study of different greenhouse environment control instruments; Study of operation maintenance and fault detection in irrigation system; Study of operation maintenance and fault detection in fogging system; Economic analysis of greenhouses and net houses; Visit to greenhouses.

Lecture schedule

1. Protected cultivation: Introduction, History, origin and development
2. National and International Scenario, components of green house, perspective
3. Types of green houses
4. Polyhouses /shed nets
5. Cladding materials
6. Plant environment interactions – principles of limiting factors, solar radiation and transpiration.
7. Greenhouse effect, light, temperature, relative humidity and carbon dioxide enrichment
8. Greenhouse effect, light, temperature, relative humidity and carbon dioxide enrichment
9. Design and construction of green houses – site selection
10. Greenhouse orientation, design and construction
11. Design for ventilation requirement using exhaust fan system, selection of equipment
12. Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators.
13. Evaporative cooling, different shading material fogging, combined fogging and fan-pad cooling system.
14. Design of cooling system, maintenance of cooling and ventilation systems, pad care etc.
15. Design of cooling system, maintenance of cooling and ventilation systems, pad care etc.
16. Greenhouse heating – necessity, components, methods.
17. Design of greenhouse heating system.
18. Root media – types – soil and soil less media, composition, estimation and preparation
19. Disinfection and bed preparation
20. Mid Examination
21. Planting techniques in green house cultivation
22. Irrigation in greenhouse and net house
23. Water quality, types of irrigation system, components, design, installation and material requirement.
24. Fogging system for greenhouses and net houses – introduction, benefits
25. Design, installation and material requirement of fogging system
26. Maintenance of irrigation system
27. Maintenance of fogging system
28. Principles of selection of proper application of fertilizers, fertilizer scheduling
29. Rate of application of fertilizers, methods, automated fertilizer application
30. Greenhouse climate measurement and control
31. Greenhouse climate measurement and control
32. Insect and disease management in greenhouse and net houses,
33. Selection of crops for greenhouse cultivation
34. Major crops in greenhouse – irrigation requirement, fertilizer management and cultivation
35. Harvesting of greenhouse crops and post harvest techniques
36. Economic analysis

Practical schedule

1. Estimation of material requirement for construction of greenhouse
2. Determination of fertilization schedule and rate of application for various crops
3. Estimation of material requirement for preparation of root media
4. Root media preparation, bed preparation and disinfections
5. Root media preparation, bed preparation and disinfections
6. Study of different planting techniques
7. Design and installation of irrigation system
8. Design and installation of irrigation system
9. Design and installation of fogging system
10. Design and installation of fogging system

11. Greenhouse heating
12. Study of different greenhouse environment control instruments
13. Study of operation maintenance and fault detection in irrigation system
14. Study of operation maintenance and fault detection in fogging system
15. Economic analysis of greenhouses and net houses
16. Economic analysis of greenhouses and net houses
17. Visit to greenhouses
18. Final Practical Examination

Suggested Readings

- Ernst van Heurn and Kees Van der Post. 2004. Protected Cultivation. Digigrafi, Wageningen, The Netherlands.
- Peter, K.V. and Sing D.K. 2013. Protected Cultivation of Horticulture Crops, New India Publishing Company.
- Reddy P.P. 2016. Sustainable Crop Protection under Protected Cultivation. Springer Singapore.
- Sharma P. 2007. Precision Farming. Daya Publishing House New Delhi
- Singh Brahma and Balraj Singh. 2014. Advances in protected cultivation, New India Publishing Company.

Ellw.4205 Water Quality and Management Measures 3(2+1)

Objective

1. To familiarize the water quality in relation to domestic, industrial and agricultural activities.
2. To impart awareness of impurities which contaminated the surface and ground water and also give the awareness on its control and management measures.

Theory

Module I

(10 Hours)

Natural factors affecting quality of surface water and groundwater, water quality objectives in relation to domestic, industrial and agricultural activities, drinking water quality standards, irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria.

Module II

(14 Hours)

Impurities in water. Point and non-point water pollution sources, water contamination due to inorganic and organic compounds, water contamination related to agricultural chemicals, food industry, hydrocarbon and synthetic organic compounds.

Module III

(12 Hours)

Arsenic and fluoride contamination in groundwater and remedial measures, water decontamination technologies, cultural and management practices for using poor quality water for irrigation. Modelling studies in water pollution.

Practical

Water quality analysis and classification according to USSL and AICRP criteria; soil chemical analysis and estimation of lime and gypsum requirements; Determination of dissolved impurities and suspended impurities. Bacteriological test of water, study of salinity development under shallow and deep water table conditions; study of contamination movement and transport in soil profile; study of different water decontamination techniques; study of different cultural and

management practices for using poor quality water for irrigation; field visit to industrial effluent disposal sites.

Lecture schedule

- 1-2. Natural factors affecting quality of surface water and groundwater
- 3-4. Water quality objectives in relation to domestic, industrial and agricultural activities
- 5-6. Drinking water quality standards, irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria.
- 7-9. Physical, Chemical and Biological impurities in water and its analysis
- 10-11. Point and non-point water pollution sources, water contamination due to inorganic compounds
- 12-13. Point and non-point water pollution sources, water contamination due to organic compounds
- 14-16. Water contamination related to agricultural chemicals & food industry and its control measures
- 17-18. Water contamination related to hydrocarbon and synthetic organic compounds and its control measures.
19. Problems.
20. Mid Examination
- 21-22. Arsenic contamination in groundwater and remedial measures
- 22-25. Fluoride contamination in groundwater and remedial measures
- 26-30. Water decontamination technologies.
- 31-33. Cultural and management practices for using poor quality water for irrigation.
- 34-36. Modelling studies in water pollution.

Practical

1. Water quality analysis and classification according to USSL criteria
2. Water quality analysis and classification according to AICRP criteria
3. Determination of dissolved impurities
4. Determination of dissolved impurities
5. Determination of suspended impurities
6. Determination of suspended impurities
7. Bacteriological test of water
8. Bacteriological test of water
9. Soil chemical analysis and estimation of lime and gypsum requirements;
10. Study of salinity development under shallow water table conditions
11. Study of salinity development under deep water table conditions
12. Study of contamination movement and transport in soil profile
13. Study of different water decontamination techniques
14. Study of different water decontamination techniques
15. Study of different cultural and management practices for using poor quality water for irrigation;
16. Study of different cultural and management practices for using poor quality water for irrigation;
17. Field visit to industrial effluent disposal sites.
18. Final Practical Examination

Suggested Readings

- FAO. 1996. Control of water pollution from agriculture - FAO irrigation and drainage paper 55.
- Gray, N.F. Water Technology. Raj Kamal Electric Press, Kundli, Haryana.

- Hussain, S.K. 1986. Text Book of Water Supply and Sanitary Engineering. Oxford & IBH Publishing Co. New Delhi.
- Manahan, S.E. 2009. Fundamentals of Environmental Chemistry. CRC Press, New York.
- McGauhey, P.H. 1968. Engineering Management of water quality. McGraw Hill Book Company, New York.
- Minhas, P.S. and Tyagi, N.K. 1998. Guidelines for irrigation with saline and alkali waters. Bull. No, 1/98, CSSRI, Karnal, p. :36.
- Punmia, B.C. and Lal, P.B.B. 1981. Irrigation and water power engineering. Standard Publishers Distributors, Delhi.

Ellw.4206 Applications of Plastic in Agriculture 3(2+1)

Objective

- To study the different plastic products used in agricultural sector
- To study the innovations in plasticulture for improving the production.

Theory

Module I

(8 Hours)

Introduction of plasticulture - types and quality of plastics used in soil and water conservation, production agriculture and post harvest management. Quality control measures. Present status and future prospective of plasticulture in India.

Module II

(10 Hours)

Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir. Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Use of polymers in control of percolation losses in fields. Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation.

Module III

(8 Hours)

Nursery management - Use of plastics in nursery raising, nursery bags, trays etc. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers. Plastic nets for crop protection - anti insect nets, bird protection nets.

Module IV

(10 Hours)

Plastic fencing. Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products. Plastics for aquacultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries. Silage film technique for fodder preservation. Agencies involved in the promotion of plasticulture in agriculture at national and state level.

Lecture Schedule

1. Introduction of plasticulture
2. Introduction of plasticulture
3. Types and quality of plastics used in soil and water conservation, production agriculture and post harvest management.
4. Types and quality of plastics used in soil and water conservation, production agriculture and post harvest management.

5. Types and quality of plastics used in soil and water conservation, production agriculture and post harvest management.
6. Quality control measures
7. Quality control measures
8. Present status and future prospective of plasticulture in India.
9. Present status and future prospective of plasticulture in India.
10. Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir.
11. Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir.
12. Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir.
13. Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Use of polymers in control of percolation losses in fields.
14. Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Use of polymers in control of percolation losses in fields.
15. Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Use of polymers in control of percolation losses in fields.
16. Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation
17. Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation
18. Nursery management - Use of plastics in nursery raising, nursery bags, trays etc.
19. Nursery management - Use of plastics in nursery raising, nursery bags, trays etc.
20. Mid Examination
21. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers
22. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers
23. Plastic nets for crop protection - anti insect nets, bird protection nets..
24. Plastic nets for crop protection - anti insect nets, bird protection nets..
25. Plastic fencing, Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products.
26. Plastic fencing, Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products.
27. Plastic fencing, Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products.
28. Plastics for aqua cultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries
29. Plastics for aqua cultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries
30. Plastics for aqua cultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries
31. Plastics for aqua cultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries
32. Silage film technique for fodder preservation.
33. Silage film technique for fodder preservation.
34. Agencies involved in the promotion of plasticulture in agriculture at national and state level.
35. Agencies involved in the promotion of plasticulture in agriculture at national and state level.

36. Agencies involved in the promotion of plasticulture in agriculture at national and state level.

Practical

1. Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting ponds.
2. Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting ponds.
3. Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting ponds.
4. Study of components of subsurface drainage system.
5. Study of components of subsurface drainage system.
6. Study of components of subsurface drainage system.
7. Study of different colour plastic mulch laying.
8. Study of different colour plastic mulch laying.
9. Design, estimation and installation of green, poly and shade net houses, low tunnels etc.
10. Design, estimation and installation of green, poly and shade net houses, low tunnels etc.
11. Design, estimation and installation of green, poly and shade net houses, low tunnels etc.
12. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters, preparation of vermi-bed and silage film for fodder preservation.
13. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters, preparation of vermi-bed and silage film for fodder preservation.
14. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters, preparation of vermi-bed and silage film for fodder preservation.
15. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters, preparation of vermi-bed and silage film for fodder preservation.
16. Visits to nearby manufacturing units/dealers of PVC pipes, drip and sprinkler irrigation systems, greenhouse/ polyhouse/shadehouse/nethouse etc.
17. Visits to farmers' fields with these installations.
18. Final Practical Examination

Suggested Readings

- Brahma Singh, Balraj Singh, NavedSabir and MurtazaHasan. 2014. Advances in Protected Cultivation. New India Publishing Agency, New Delhi.
- Brown, R.P. 2004. Polymers in Agriculture and Horticulture. [RAPRA Review Reports : Vol. 15, No. 2, RAPRA Technology Limited, U.K.](#)
- Central Pollution Control Board. 2012. Material on Plastic Waste Management. PariveshBhawan, East Arjun Nagar, Delhi-110032.
- Charles A. Harper. 2006. Handbook of Plastics Technologies. The Complete Guide to Properties and Performance. McGraw-Hill, New Delhi.
- Dubois. 1978. Plastics in Agriculture. Applied Science Publishers Limited, Essex, England.
- ManasChanda, Salil K. Roy. 2008. Plastics Fundamentals, Properties, and Testing. CRC Press.
- Ojha, T.P. and Michael, A.M., 2012, Principles of Agricultural Engineering - I. Jain Brothers, Karol Bagh, New Delhi.
- Pandey, P.H. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana, India.
- Shankar, A.N. 2014. Integrated Horticulture Development in Eastern Himalayas, Plasticulture in Agri-Horticulture Systems, 241-247.
- Srivastava, R.K., R.C. Maheswari, T.P. Ojha, and A. Alam. 1988. Plastics in Agriculture. Jain Brothers, Karol Bagh, New Delhi.

Ellw.4207 Quantity Surveying and Valuation 3(2+1)

Objectives

After studying the subject, the student should be able

1. To set out any agricultural engineering work and to prepare estimates.
2. To have a thorough idea regarding the quality and quantity of materials, quantity and classes of skilled and unskilled labours and tools and plants required for the project.
3. To calculate the exact quantities of items of work done for affecting payment
4. To mould themselves as entry level graduate engineers competent to manage any agricultural engineering project confidently either alone or jointly.

Theory

Module I (12 Hours)

Estimation – basic terms - types of estimates - revised estimate – supplementary estimate - maintenance estimate - approximate estimate - plinth area method – cubic rate method - unit rate method - bay method - approximate quantity from bill method - comparison method - cost from materials and labour etc. - preparation of detailed estimate for buildings - centre line method and ‘long wall - short wall’ method .

Module II (10 Hours)

Methods of measurements of different items of work - preparation detailed estimate for sanitary and water supply works - roads - irrigation works - steel structures – doors and windows - R C C Structures - Preparation of bar bending schedule.

Module III (7 Hours)

Detailed specifications for common building materials and items of work as per I.S specifications - preparation of conveyance statement - calculation of quantities of materials for items of work - analysis of rate for items of works required for agricultural engineering works - preparation of abstract of estimate of agricultural engineering works. Measurement books.

Module IV (7 Hours)

Valuation - explanation of items - types of values - sinking fund - years purchase - depreciation - straight line method - constant percentage method - S.F method - obsolescence - valuation of real property - rental method - profit based method - depreciation method - valuation of land - belting method - development method - hypothecated building scheme method - rent calculation - lease and lease hold property.

Practical

Study of different types of estimates.Preparation of detailed estimate.Preparation of detailed estimate for buildings. Preparation of detailed estimate for irrigation works. Preparation of detailed estimate for greenhouses. Preparation of detailed estimate for water supply works. Preparation of detailed estimate for Roads. Preparation of detailed estimate for drainage works. Preparation of detailed estimate for check dams.Preparation of detailed estimate for water harvesting structures.Preparation of detailed estimate for dairy barn.Preparation of detailed estimate for storage structures.Methods of measurements of different items of work. Analysis of rate for items of works required for agricultural engineering works. Preparation of abstract of estimate.Measurement and writing measurement book. Visit to a work site.

Lecture Schedule

Theory

- 1-2 Introduction to estimation and costing – basic terms
- 3 - 4 Methods of estimation
- 5 Types of estimates
- 6 Revised estimate
- 7 Supplementary estimate
- 8 Maintenance estimate
- 9 Approximate estimate
- 10 Plinth area method – cubic rate method - unit rate method - bay method
- 11 Approximate quantity from bill method - comparison method - cost from materials and labour etc.
- 12 - 14 Preparation of detailed estimate for buildings - centre line method and ‘long wall - short wall’ method.
- 15 - 16 Methods of measurements of different items of work
- 17 - 18 Preparation detailed estimate for sanitary and water supply works
- 19 Preparation detailed estimate for roads
- 20 Mid Examination
- 21 Preparation detailed estimate for steel structures
- 22 Preparation detailed estimate for doors and windows
- 23 Preparation detailed estimate for R C C Structures
- 24 Preparation of bar bending schedule.
- 25 Detailed specifications for common building materials and items of work as per I.S specifications
- 26 Preparation of conveyance statement
- 27 Calculation of quantities of materials for items of work
- 28 Analysis of rate for items of works required for agricultural engineering works
- 29 Preparation of abstract of estimate of agricultural engineering works. Measurement books.
- 30 Valuation - explanation of items - types of values - sinking fund - years purchase
- 31 - 32 Depreciation - straight line method - constant percentage method - S.F method - obsolescence
- 33 –36 valuation of real property - rental method - profit based method - depreciation method - valuation of land - belting method - development method - hypothecated building scheme method - rent calculation - lease and lease hold property.

Practical

1. Study of different types of estimates.
2. Preparation of detailed estimate.
3. Preparation of detailed estimate for buildings.
4. Preparation of detailed estimate for irrigation works.
5. Preparation of detailed estimate for greenhouses.
6. Preparation of detailed estimate for water supply works.
7. Preparation of detailed estimate for Roads.
8. Preparation of detailed estimate for drainage works.
9. Preparation of detailed estimate for check dams.
10. Preparation of detailed estimate for water harvesting structures.
11. Preparation of detailed estimate for dairy barn.
12. Preparation of detailed estimate for storage structures.
13. Methods of measurements of different items of work.
14. Analysis of rate for items of works required for agricultural engineering works.
15. Preparation of abstract of estimate.
16. Measurement and writing measurement book.

17. Visit to a work site.
18. Final Practical Examination

Suggested Readings

Chakraborti, M. Estimating costing & Specification in Civil Engineering

Dutta, B.N. (2007) Estimating and costing in civil engineering. USB publishers distributors, New Delhi.

Rangawala, S.C. Valuation of real properties

Department of Food & Agricultural Process Engineering- Core courses

Fape 1101. Engineering Properties of Agricultural Produce 2 (1+1)

Objectives

To acquaint and equip the students with different engineering properties and its application in design of food processing equipments.

Theory

Module I (8 Hours)

Classification and importance of engineering properties of Agricultural Produce, shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area of grains, fruits and vegetables, Thermal properties, Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion, Friction in agricultural materials; Static friction, Kinetic friction, rolling resistance, angle of internal friction, angle of repose, Flow of bulk granular materials, Aero dynamics of agricultural products, drag coefficients, terminal velocity.

Module II (7 Hours)

Rheological properties; force, deformation, stress, strain, elastic, plastic and viscous behaviour, ideal classical models, rheological models, Newtonian and Non-Newtonian liquid, Visco-elasticity, Newtonian and Non-Newtonian fluid, Pseudo-plastic, Dilatant, Thixotropic, Rheopectic and Bingham Plastic Foods, Flow curves.

Module III (2 Hours)

Electrical properties; dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination. Application of engineering properties in handling processing machines and storage structures.

Practical

Determination of the shape and size of grains, fruits and vegetables, Determination of bulk density and angle of repose of grains, Determination of the particle density/true density and porosity of solid grains, Finding the co-efficient of external and internal friction of different crops, Finding out the terminal velocity of grain sample and study the separating behaviour in a vertical wind tunnel, Finding the thermal conductivity of different grains, Determination of specific heat of some food grains, Determination of hardness of food material and determination of viscosity of liquid foods.

Lecture schedule:

1. Introduction - engineering properties of biological material- classification and importance.
2. Physical properties- shape- size – roundness –Sphericity- application.
3. Physical properties-volume – density- porosity- specific gravity- surface area of grains- fruits and vegetables- application.
4. Thermal properties- heat capacity- specific heat- thermal conductivity-thermal diffusivity- application.

5. Heat of respiration-co-efficient of thermal expansion.
6. Friction in agricultural materials-static friction- kinetic friction- rolling resistance- angle of internal friction- angle of repose- application.
7. Flow of bulk granular materials.
8. Aero dynamics of agricultural products- drag coefficients- terminal velocity.
9. Rheological properties- force- deformation- stress- strain- elastic- plastic and viscous behaviour.
10. Midterm Examination
11. Ideal rheological models- Hookean body- St.Venant body- Newtonian fluid.
12. Rheological models- Kelvin model- generalized Kelvin model
13. Rheological models- Maxwell model- generalized Maxwell model- 4 element burger model
14. Rheological models- Maxwell model- generalized Maxwell model- 4 element burger model- application.
15. Newtonian and Non-Newtonian liquid-visco-elasticity.
16. Pseudo-plastic-dilatant- thixotropic- rheopectic- Bingham Plastic Foods - flow curves- application- examples.
17. Electrical properties- dielectric loss factor- loss tangent- A.C. conductivity and dielectric constant- method of determination.
18. Application of engineering properties in handling processing machines and storage structures

Practical schedule:

1. Determination of surface area of the agricultural materials
2. Determination of the shape and size of grains.
3. Determination of the shape and size of fruits and vegetables
4. Determination of bulk density
5. Determination of specific gravity
6. Determination of angle of repose of grains
7. Determination of the particle density/true density and porosity of solid grains
8. Finding the co-efficient of external and internal friction of different crops
9. Determination of filling angle of repose
10. Determination of emptying angle of repose
11. Finding out the terminal velocity of grain sample
12. Study the separating behavior in a vertical wind tunnel
13. Finding the thermal conductivity of different grains
14. Determination of specific heat of some food grains
15. Determination of hardness of food material
16. Determination of rheological properties of food material
17. Determination of viscosity of liquid foods.
18. Final Practical examination

Suggested Readings

1. Mohesin, N.N. 1980. Physical Properties of Plants & Animals. Gordon & Breach Science Publishers , New York.
2. Mohesin, N.N. 1980. Thermal Properties of Foods and Agricultural Materials. Gordon & Breach Science Publishers , New York.
3. Prentice, J.H. 1984. Measurement in Rheological Properties of Food Stuffs. Elsevier Applied science Pub. Co. Inc. New York.
4. Rao, M.A. and Rizvi, S.H., .1995. Engineering Properties of Foods. Marcel Dekker Inc. New York.
5. Singhal OP and Samuel DVK. 2003. Engineering Properties of Biological Materials. Saroj Prakashan.

Fape 2102. Post Harvest Engineering of Cereals, Pulses and Oil Seeds 3(2+1)

Objectives

To acquaint and equip the students with the post-harvest technology of major cereals, pulses and oilseeds with special emphasis on their equipments and also to create awareness on various unit operations related to these crops.

Theory

Module I

(12 Hours)

Cleaning and grading, aspiration, scalping; size separators, screens, sieve analysis, capacity and effectiveness of screens. Various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone, shape graders. Size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing), Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill. Material handling equipment. Types of conveyors: Belt, roller, chain and screw. Elevators: bucket, Cranes & hoists. Trucks (refrigerated/ unrefrigerated), Pneumatic conveying.

Module II

(10 Hours)

Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination, Psychrometric chart and its use in drying, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Mass and energy balance, Shedd's equation, Dryer performance, Different methods of drying, batch-continuous; mixing-non-mixing, Sun-mechanical, conduction, convection, radiation, superheated steam, tempering during drying, Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray. Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes.

Module III

(6 Hours)

Milling of rice: Conditioning and parboiling, advantages and disadvantages, traditional methods, CFTRI and Jadavpur methods, Pressure parboiling method, Types of rice mills, Modern rice

milling, different unit operations and equipment. Milling of wheat, unit operations and equipment. By-products utilization

Module IV

(7 Hours)

Milling of pulses: traditional milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods: CFTRI and Pantnagar methods. Pulse milling machines, Milling of corn and its products. Dry and wet milling. Milling of oilseeds: mechanical expression, screw press, hydraulic press, solvent extraction methods, preconditioning of oilseeds, refining of oil, stabilization of rice bran., Extrusion cooking: principle, factors affecting, single and twin screw extruders..

Practical

Performance evaluation of different types of cleaners and separators, Determination of separation efficiency, Study of different size reduction machines and performance evaluation, Determination of fineness modulus and uniformity index, Study of different types of conveying and elevating equipments, Study of different types of mixers. Measurement of moisture content: dry basis and wet basis, Study on drying characteristics of grains and determination of drying constant, Determination of EMC (Static and dynamic method), Study of various types of dryers, Study of different equipments in rice mills and their performance evaluation, Study of different equipments in pulse mills and their performance evaluation, Study of different equipments in oil mills and their performance evaluation, Type of process flow charts with examples relating to processing of cereals pulses and oil seeds, Visit to grain processing industries.

Lecture schedule:

1. Cleaning and grading - types of screen-screen opening- ideal and actual screen – Effectiveness of screen.
2. Equipments for cleaning and grading – Air-screen cleaners – Rotary screen cleaner.
3. Various types of separators - disk separator – Indented cylinder separator – Spiral separator - specific gravity separator.
4. Separators –Destoner – Inclined draper – Velvet roll separator - magnetic, pneumatic separator.
5. Separators - colour sorters- cyclone separators – graders – rotating reel graders.
6. Size reduction – sieve analysis –fineness modulus - average size of particle.
7. Size reduction - principles of comminution - Bond's law- Kick's law - Rittinger's law- Size reduction procedures-crushing, impact, cutting and shearing
 8. Size reduction machinery – introduction- types -jaw crusher – gyratory crusher – crushing rolls - grinders – attrition mill- hammer mill-ball mill – cutting machines.
 9. Size reduction machinery – introduction- types -jaw crusher – gyratory crusher – crushing rolls - grinders – attrition mill- hammer mill-ball mill – cutting machines.
10. Material handling equipment- types of conveyors-belt conveyor- bucket elevator- screw conveyor.
11. Design considerations of material handling devices-capacity- power requirement.
12. Elevators: Cranes & hoists. Trucks (refrigerated/ unrefrigerated), Pneumatic conveying.

13. Drying- theory of grain drying - moisture content and water activity - Free, bound and unbound moisture - moisture content determination methods – Direct and indirect methods.
14. Hysteresis effect-Equilibrium moisture content- EMC determination - psychrometry- Psychrometric chart .
15. Psychrometric processes- solving problems.
16. Drying principles - thin layer and deep bed drying analysis, falling rate and constant rate drying period- critical moisture content- maximum and decreasing drying rate period.
17. Drying equations-solving problems
18. Drying models-Mass and energy balance, Shedd's equation, Dryer performance,
19. Different methods of drying – sun drying – mechanical drying –contact drying, convective drying , freeze drying, radiation drying, osmotic drying, vacuum drying, fluidized bed drying, desiccated air drying and super heater steam drying.
20. Midterm Examination
21. Grain dryers- introduction- batch- continuous -mixing-non-mixing
22. Different types of grain dryers- Deep bed dryer- flat bed dryer-continuous flow dryer-recirculating dryer-LSU dryer-fluidized bed dryer- rotary dryer- RPEC- tray dryer.
23. Mixing-introduction-theory of mixing-equipments- mixers for solid, liquid, paste and high viscous masses-mixing index-rate of mixing -effectiveness.
24. Paddy-production, structure and composition of paddy- Parboiling of paddy- merits and demerits—traditional methods- modern methods-CFTRI and Jadavpur methods - Pressure parboiling method.
25. Dehusking of paddy- traditional methods- pounding of paddy – Modern methods- Engleburg huller, Under runner disk huller – centrifugal dehusker
26. Milling of paddy- rubber roll sheller – paddy separator – Husk separator –Whitening – vertical whitening cone – horizontal abrasive whitener
27. Rice polishers – vertical polishing cone – horizontal polisher- rice graders-milling efficiency
28. Products and by products from paddy- utilization of rice bran and rice husk- layout of a modern rice mill - Rice products-beaten rice- puffed rice.
29. Wheat-production, structure and composition of wheat- conditioning of wheat-milling of wheat- unit operations and equipment-components of a wheat mill.
30. Pulses-production, structure and composition- types-unit operations in pulse milling-conventional methods of milling of pulses- commercial methods,
31. Commercial methods of milling of pulses- dry milling and wet milling methods: CFTRI and Pant nagar methods- pulse milling machines.
32. Corn- production, structure and its composition-corn dry milling- process in dry milling- Wet milling-process- corn wet milling products.
33. Oil seeds- production status- status of oil milling in India- oil extraction methods-expression and extraction- expression devices- hydraulic press-screw press-filtration equipment-plate and frame filter press.
34. Solvent extraction- principles-method-types of extractors.

35. Rice bran oil-stabilization of rice bran- composition of fatty acids in rice bran oil- extraction of rice bran oil-refining of rice bran oil-uses of rice bran oil.
36. Extrusion cooking-introduction- principle-types-Single and twin screw extruders.

Practical schedule:

1. Performance evaluation of different types of cleaners and separators
2. Determination of separation efficiency
3. Study of different size reduction machines and performance evaluation
4. Determination of fineness modulus and uniformity index
5. Study of different types of conveying and elevating equipments
6. Study of different types of mixers.
7. Measurement of moisture content: dry basis and wet basis
8. Study on drying characteristics of grains
9. Determination of drying constant
10. Determination of EMC (Static and dynamic method)
11. Study of various types of dryers
12. Study of various types of dryers
13. Study of different equipments in rice mills and their performance evaluation
14. Study of different equipments in pulse mills and their performance evaluation
15. Study of different equipments in oil mills and their performance evaluation
16. Type of process flow charts with examples relating to processing of cereals pulses and oil seeds
17. Visit to grain processing industries.
18. Final Practical examination

Suggested Readings

1. Chakraverty, A. 1995. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
2. Dash, S.K., Bebartta, J.P. and Kar, A. 2012. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.
3. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
4. Geankoplis C. J. 1997. Transport processes and unit operations, Prentice Hall of India Pvt Ltd, New Delhi
5. McCabe, W.L., Smith J.C. and Harriott, P. 2005. Unit operations of Chemical Engineering. McGraw Hill.
6. Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.
7. Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.

Objective:

- To impart the concept of various modes of heat and mass transfer.
- To develop understanding about the method of determination of heat transfer rates in conduction, convection and radiation.
- To impart the concept of various heat exchangers.

Theory

Module I (12 Hours)

Concept, modes of heat transfer, thermal conductivity of materials, measurement. General differential equation of conduction. One dimensional steady state conduction through plane and composite walls, tubes and spheres with and without heat generation. Electrical analogy. Insulation materials, fins.

Module II (8 Hours)

Free and forced convection. Newton's law of cooling, heat transfer coefficient in convection. Dimensional analysis of free and forced convection. Useful non dimensional numbers. Equation of laminar boundary layer on flat plate and in a tube. Laminar forced convection on a flat plate and in a tube. Combined free and forced convection.

Module III (7 Hours)

Radiation heat transfer-Introduction. Absorptivity, reflectivity and transmissivity of radiation. Black body and monochromatic radiation, Planck's law, Stefan-Boltzman law, Kirchoff's law, grey bodies and emissive power, solid angle, intensity of radiation. Radiation exchange between black surfaces, geometric configuration factor.

Module IV (8 Hours)

Types of heat exchangers, fouling factor, log mean temperature difference, heat exchanger performance, transfer units. Heat exchanger analysis restricted to parallel and counter flow heat exchangers. Steady state molecular diffusion in fluids at rest and in laminar flow, Fick's law, mass transfer coefficients. Reynold's analogy.

Lecture Schedule

1. Introduction to modes of heat transfer- conduction, convection and radiation
2. Mechanism of thermal conduction in solids, liquids and gases.
3. Fourier's law, heat transfer at the interference of two solids.
4. Electrical analogy in heat transfer
5. Thermal conductivity of materials.
6. Three dimensional Fourier conduction equations- derivations.
7. Steady state unidirectional heat flow through slabs, cylinders and spheres.
8. One dimensional steady state conduction through plane wall with uniform heat generation.
9. One dimensional steady state conduction through cylinder with uniform heat generation.
10. One dimensional steady state conduction through sphere with uniform heat generation.
11. Insulators-introduction –purpose-critical thickness of insulation.
12. Heat transfer through fins
13. Introduction to free and forced convection

14. Newton's law of cooling
15. Heat transfer coefficient in convection
16. Dimensional analysis of free and forced convection
17. Useful non dimensional numbers
18. Equation of laminar boundary layer on flat plate and in a tube
19. Laminar forced convection on a flat plate and in a tube
20. Mid semester examination
21. Combined free and forced convection
22. Fundamentals of radiation – radiation spectrum – thermal radiation
23. Concept of black body and grey body
24. Absorptivity, reflectivity and transmissivity of radiation
25. Monochromatic radiation and total emissive power
26. Planck's law, Stefan-Boltzman law, Kirchoff's law
27. Intensity of radiation. Radiation exchange between black surfaces
28. Radiation between two surfaces - geometric configuration factor.
29. Introduction to Heat exchangers-Types of heat exchangers
30. Fouling factor, scaling, log mean temperature difference (LMTD)
31. Heat exchanger performance, transfer units
32. Heat exchanger analysis restricted to parallel and counter flow heat exchangers
33. NTU method of performance evaluation of heat exchangers.
34. Steady state molecular diffusion in fluids at rest and in laminar flow
35. Introduction to mass transfer – Fick's law of diffusion
36. Mass transfer coefficients. Reynold's analogy.

Suggested Readings

1. R. K. Rajput, Heat and Mass Transfer, S. Chand and Company Pvt. Ltd.
2. P. K. Nag, Heat and Mass Transfer, Tata McGraw Hill.
3. Sachedeva, Heat and Mass Transfer, New Age International.
4. D. S. Kumar, Heat and Mass Transfer.
5. Holman, Heat and Mass Transfer, McGraw Hill.

Fape 3104. Agricultural Structures and Environmental Control 3 (2+1)

Objectives

This course is designed to impart a thorough understanding of the design and construction of various farm structures which an agricultural engineer ought to design. The course also highlights various standards and the environmental parameters involved in the design of such structures.

Theory

Module I

(6 Hours)

Planning and layout of farm stead. Scope, importance and need for environmental control, physiological reaction of livestock, environmental factors, environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods, Livestock production facilities, BIS Standards for dairy, piggery, poultry and other farm structures.

Module II (10 Hours)

Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc.

Module III (9 Hours)

Storage of grains, Causes of spoilage, Water activity for low and high moisture food and its limits for storage, Moisture and temperature changes in grain bins; Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins), Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin, Calculation of pressure in bins, Storage of seeds.

Module IV (10 Hours)

Rural living and development, rural roads, their construction cost and repair and maintenance. Sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community. Site and orientation of building in regard to sanitation, community sanitation system; sewage system and its design, cost and maintenance, design of septic tank for small family. Estimation of domestic power requirement, source of power supply and electrification of rural housing.

Practical

Measurements for environmental parameters and cooling load of a farm building, Design and layout of a dairy farm, Design and layout of a poultry house, Design and layout of a goat house/sheep house, Design of a farm fencing system, Design of a feed/fodder storage structures, Design of grain storage structures, Design and layout of commercial bag and bulk storage facilities, Study and performance evaluation of different domestic storage structure, Estimation of a Farm building.

Lecture schedule:

1. Farmstead – location of farm stead – size and arrangement- planning
2. Physiological reaction of livestock to solar radiation and environmental factors
3. Environment control systems and their design
4. Control of temperature, Humidity and other factors by ventilation and others methods
5. BIS- introduction- objectives- importance- standards for dairy
6. BIS Standards for dairy, piggery, poultry and other farm structures.
7. BIS for poultry- piggery and other important structures
8. Design, construction and cost estimation of farm fencing systems- fencing posts
9. Compost pit – mechanism of composting-types of composting
10. Design, construction and cost estimation of compost pit
11. Fodder silo – types - Design construction and cost estimation of fodder silo.
12. Design, construction and cost estimation of implement shed
13. Dairy barns – types- design parameters
14. Design, construction and cost estimation of stanchion barn.
15. Poultry house – types- general design factors
16. Design and construction of deep litter and wire floored poultry houses
17. Cage housing system- poultry equipments

18. Storage of grains, Causes of spoilage, Water activity for low and high moisture food and its limits for storage
19. Moisture and temperature changes in stored grains – moisture movement
20. Traditional storage structures-Bhukari, Morai and Kothar
21. Midterm Examination
22. Improved storage structures- CAP, hermetic storage, Pusa bin, RCC ring bins
23. Grain storage silo – deep bin – shallow bin – plain of rupture
24. Lateral pressure inside bin – Janssens equation, Rankin's equation
25. Design of grain storage bin-Control of environment inside silo – aeration inside bin
26. Design and layout of bag storage structures- grain godowns
27. Constructional details of grain godowns
28. Constructional details of grain godowns- storage of seeds
29. Rural roads – types - construction
30. Maintenance and repair of rural roads
31. Sources of water supply, norms of water supply for human being and animals, drinking water standards
32. Water treatment suitable to rural community
33. Sewage system and its design, cost and maintenance
34. Design of septic tank for small family – Soak pit.
35. Source of power supply and electrification of rural housing power requirement.
36. Estimation of domestic power requirement.

Practical Schedule:

1. Estimation of cooling load of a farm building
2. Design and layout of a farm stead
3. Design and layout of a dairy barn
4. Design and layout of a poultry house
5. Design and layout of a goat house/sheep house
6. Design of a farm fencing system
7. Design of a feed/fodder storage structures
8. Design of grain storage structures – Grain bin
9. Design of grain storage structures – Grain bin
10. Design and layout of commercial bag – Grain godown
11. Study and performance evaluation of different domestic storage structure
12. Cost Estimation of a Farm building.
13. Design and layout of a farm fencing
14. Cost estimation of farm fencing and implement shed
15. Design and layout of a septic tank
16. Design and layout of a rural road
17. Design and layout of compost pit
18. Final Practical Examination

Suggested Readings

1. Banerjee, G.C. 1998. A Text Book of Animal Husbandry, Oxford IBH Publishing Co, New Delhi.
2. Dutta, B.N. 1969. Estimating and Costing in Civil Engineering, Duttta & CO, Lucknow.
3. Garg, S.K. 2001. Water Supply Engineering, Khanna Publishers, New Delhi-6.
4. Nathanson, J.A. 2003. Basic Environmental Technology, Prentice Hall of India, New Delhi.
5. Ojha, T.P and Michael, A.M. 2002. Principles of Agricultural Engineering, Vol. I, Jain Brothers, Karol Bag, New Delhi.
6. Pandey, P.H. 2004. Principles and practices of Agricultural Structures and Environmental Control, Kalyani Publishers, Ludhiana.
7. Sahay, K.M. and Singh, K.K. 1994. Unit Operations of Agricultural Processing, Vikas publishing pvt. Ltd, Noida.
8. Venugopal Rao, P. 2002. Text Book of Environmental Engineering, Prentice Hall of India, New Delhi.

Fape 3105. Refrigeration and Air Conditioning 3 (2+1)

Objectives

To impart the concept of the basic principles, working, scientific analysis and system components of different types of refrigeration and air conditioning systems and also to impart the knowledge of various types of refrigerants, their properties, selection criteria and environmental aspects.

Theory

Module I

(10 Hours)

Laws of thermodynamics. Carnot cycle and reversed Carnot cycle. Principles of refrigeration, units, terminology, production of low temperatures, air refrigerators working on reverse Carnot cycle and Bell Coleman cycle. Vapour refrigeration-mechanism, P-V, P-S, P-H diagrams.

Module II

(9 Hours)

Vapour compression cycles, dry and wet compression, super cooling and sub cooling. Types of refrigeration systems- Electrolux and steam jet refrigeration systems. Components of mechanical refrigerator. Study of compressors, condensers, expansion devices and evaporators. Vapour absorption refrigeration system.

Module III

(10 Hours)

Methods of refrigeration. Common refrigerants and their properties. Design calculations for refrigeration system. Cold storage plants. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process.

Module IV

(6 Hours)

Air conditioning – principles – Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods, fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling load calculations, types of air conditioners – applications.

Practical

Tutorials on thermodynamic air cycles, Study and application of P V and T S chart in refrigeration, P H chart (or) Mollier diagram in refrigeration, Numerical on air refrigeration cycle systems, Numerical on vapour compression cycle refrigeration system, Study of domestic water cooler, Study of domestic household refrigerator, Study of absorption type solar refrigeration system, Study cold storage for fruit and vegetables, Freezing load and time calculations for food materials, Determination of refrigeration parameters using refrigeration tutor – II, Numerical on design of air conditioning systems, Study of window air conditioner, Study on repair and maintenance of refrigeration and air-conditioning systems. Visit to chilling or ice making and cold storage plants.

Lecture Schedule:

1. Thermodynamics properties
2. Gas laws -Laws of thermodynamics
3. Carnot cycle and reversed Carnot cycle
4. Air refrigerator working on reversed Carnot cycle and Bell-Coleman cycle
5. Entropy and enthalpy
6. Principles of refrigeration
7. Refrigeration- introduction-COP-units and terminology
8. Air refrigerators working on reverse Carnot cycle and Bell Coleman cycle
9. Vapour refrigeration-mechanism
10. P-V, P-S, P-H diagrams
11. Vapour compression cycles
12. Dry and wet compression
13. Super cooling and sub cooling
14. Components of mechanical refrigeration-study of compressors
15. Study of condensers
16. Study of expansion devices
17. Study of evaporators
18. Vapour absorption refrigeration system
19. COP of absorption refrigeration system-advantages of vapour absorption over vapour compression system
20. Mid semester examination
21. Methods of refrigeration-Electolux refrigerator
22. Methods of refrigeration-steam jet refrigeration system
23. Common refrigerants and their properties.
24. Design calculations for refrigeration system
25. Cold storage plants-design of a cold storage plant
26. Cooling load estimation
27. Psychrometry-Introduction-psychrometric terms
28. Psychrometric process-by pass factor of heating and cooling coils
29. Psychrometric chart and its use

30. Sensible heat factor-adiabatic mixing of two air streams
31. Air conditioning – principles, type and functions of air conditioning
32. Physiological principles in air conditioning
33. Room sensible heat factor-grand sensible heat factor
34. Air distribution and duct
35. Types of air conditioners – applications
36. Application of refrigeration and air conditioning in food industry

Practical Schedule:

1. Tutorials on thermodynamic air cycles
2. Study and application of P V chart in refrigeration
3. Study and application of T S chart in refrigeration
4. Study and application of P H chart (or) Mollier diagram in refrigeration
5. Tutorialson air refrigeration cycle systems
6. Tutorials on vapour compression cycle refrigeration system
7. Study of domestic water cooler
8. Study of domestic household refrigerator
9. Study of absorption type solar refrigeration system
10. Tutorials on psychrometry
11. Study of cold storage for fruit and vegetables
12. Freezing load and time calculations for food materials
13. Determination of refrigeration parameters using refrigeration tutor – II
14. Numerical on design of air conditioning systems
15. Study of window air conditioner
16. Study on repair and maintenance of refrigeration and air-conditioning systems.
17. Visit to chilling or ice making and cold storage plants.
18. Practical Examination

Suggested Readings

1. Ballney P. L. 1994. Thermal Engineering. Khanna Publishers, New Delhi.
2. Khurmi R S. 1992. Engineering Thermodynamics. S Chand and Co. Ltd., Ram Nagar, New Delhi.
3. Kothandaraman C P Khajuria P R and Arora S C. 1992. A Course in Thermodynamics and Heat Engines. DhanpetRai and Sons, NaiSarak, New Delhi.
4. Mathur M L and Mehta F S. 1992. Thermodynamics and Heat Power Engineering. DhanpatRai and Sons, NaiSarak, New Delhi.
5. Nag P K.1995. Engineering Thermodynamics. Tata McGraw Hill Publishing Co.Ltd., 12/4 Asaf Ali Raod, New Delhi.

Fape3206. Post Harvest Engineering of Horticultural Crops 2 (1+1)

Objectives

To acquaint and equip the students with processing and handling of fruits and vegetables to minimize the post harvest losses and also to facilitate the design features of the equipments used for the processing

Theory

Module I

(8 Hours)

Importance of processing of fruits and vegetables, spices, condiments and flowers. Characteristics and properties of horticultural crops important for processing, Peeling: Different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling, and thermal peeling), Slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction, etc., Blanching: Importance and objectives; blanching methods, effects on food (nutrition, colour, pigment, texture), Thermal processing of food- microbial kinetics-D value, Z value and F value-Canning of fruits and vegetables- Chilling and freezing: Application of refrigeration in different perishable food products, Thermophilic, mesophilic & Psychrophilic micro-organisms, Chilling requirements of different fruits and vegetables, Freezing of food, freezing time calculations, slow and fast freezing, Equipment for chilling and freezing (mechanical & cryogenic), Effect on food during chilling and freezing, Cold storage heat load calculations and cold storage design, refrigerated vehicle and cold chain system, Dryers for fruits and vegetables, Osmo-dehydration.

Module II

(5 Hours)

Packaging of horticultural commodities, Packaging requirements (in terms of light transmittance, heat, moisture and gas proof, micro organisms, mechanical strength), Different types of packaging materials commonly used for raw and processed fruits and vegetables products, bulk and retail packages and packaging machines, handling and transportation of fruits and vegetables, Pack house technology, Minimal processing, Common methods of storage, Low temperature storage, evaporative cooled storage, Controlled atmospheric storage, Modified atmospheric packaging.

Module III

(4 Hours)

Preservation Technology, General methods of preservation of fruits and vegetables, Brief description and advantages and disadvantages of different physical/ chemical and other methods of preservation, Flowcharts for preparation of different finished products, Important parameters and equipment used for different unit operations, Post harvest management and equipment for spices and flowers, Quality control in Fruit and vegetable processing industry. Food supply chain.

Practical

Performance evaluation of peeler and slicer, Performance evaluation of juicer and pulper, Performance evaluation of blanching equipment, Testing adequacy of blanching, Study of cold storage and its design, Study of CAP and MAP storage, Minimal processing of vegetables,

Preparation of value added products, Visit to fruit and vegetable processing industry, Visit to spice processing plant

Lecture schedule:

1. Horticultural crops-introduction-classification-importance-status of production and export value.
2. Characteristics and properties of horticultural crops important for processing.
3. Peeling and Slicing of horticultural crops- Different methods and equipments used.
4. Principles of processing and preservation: blanching- types-
5. Canning-bottling-surface coatings-chemical dips.
6. Thermal processing of food
7. Principles of processing and preservation-freezing-Refrigeration- Cold storage – cooling load calculation.
8. Thermo plasticity – chemical changes during drying.-osmotic dehydration-osmo vac dehydration and osmo air drying of fruits.
9. Drying and dehydration– importance – water activity-pretreatments before drying – drying curve – shrinkage, case hardening.
10. Midterm Examination
11. Types of dryer – tray, drum, pneumatic, spray, fluidized bed dryer ,freeze dryer and foam mat during.
12. Packaging of horticultural commodities- materials-basic requirements of packaging materials-transportation.
13. Minimal processing-fruits and vegetables-methods and principles.
14. Handling and storage-refrigerated storage-evaporative cooled storage- Modified and Controlled atmosphere storage
15. Preservation Technology- general methods of preservation of fruits and vegetables-its advantages and disadvantages.
16. Flowcharts for preparation of different finished products.
17. Post harvest management and equipment for spices and flowers.
18. Quality control in Fruit and vegetable processing industry-Food supply chain.

Practical Schedule:

1. Performance evaluation of peeler and slicer.
2. Performance evaluation of juicer and pulper.
3. Performance evaluation of blanching equipment.
4. Determination of firmness of fruit by penetrometer.
5. Testing adequacy of blanching.
6. Determination of fruit acids by titration and calculation of the sugar/acid ratio.
7. Determination of ascorbic acid.
8. Study of cold storage and its design.
9. Study of CAP and MAP storage
10. . Study of CAP and MAP storage.
11. Minimal processing of vegetables

12. Preparation of tomato products (puree, ketchup).
13. Preparation of fruit juice, Jam, jelly and RTS.
14. Moisture content determination of fruits and Vegetables.
15. Drying characteristics of fruits and vegetables using Convective dryer.
16. Determination of vase life extension of cut flowers.
17. Visit to fruit and vegetable processing industry.
18. Final Practical examination.

Suggested Readings

1. Arthey, D. and Ashurst, P. R. 1966. Fruit Processing. Chapman and Hall, New York.
2. Pandey, R.H. 1997. Postharvest Technology of fruits and vegetables (Principles and practices). Saroj Prakashan, Allahabad.
3. Pantastico, E.C.B. 1975. Postharvest physiology, handling and utilization of tropical and subtropical fruits and vegetables AVI Pub. Co., New Delhi.
4. Sudheer, K P. and Indira, V. 2007. Post Harvest Engineering of horticultural crops. New india Publishing House.

Fape 3207 Dairy and Food Engineering 3 (2+1)

Objectives

To disseminate the knowledge of properties of products, unit operations and packaging involved in dairy and food engineering.

Theory

Module I (6 Hours)

Deterioration in food products and their controls, Physical, chemical and biological methods of food preservation. Dairy development in India, Engineering, thermal and chemical properties of milk and milk products, Process flow charts for product manufacture, Unit operation of various dairy and food processing systems. Principles and equipment related to receiving of milk

Module II (13 Hours)

Pasteurization, sterilization, homogenization, centrifugation and cream separation. Preparation methods and equipment for manufacture of cheese, paneer, butter and ice cream, Filling and packaging of milk and milk products; Aseptic processing.

Module III (7 Hours)

Dairy plant design and layout, Plant utilities; Principles of operation and equipment for thermal processing, Evaporation of food products: principle, types of evaporators, steam economy, multiple effect evaporation, vapour recompression.

Module IV (9 Hours)

Drying of liquid and perishable foods: principles of drying, spray drying, drum drying, freeze drying, Filtration: principle, types of filters; Membrane separation, RO, Nano-filtration, Ultra filtration and Macro-filtration, equipment and applications, Nanotechnology: fundamental concepts.

Practical

Study of pasteurizers, Study of sterilizers, Study of homogenizers, Study of separators, Study of butter churns, Study of evaporators, Study of milk dryers, Study of freezers, Study of filtration, Design of food processing plants & preparation of layout, Visit to multi-product dairy plant, Estimation of steam requirements, Estimation of refrigeration requirements in dairy & food plant, Visit to Food industry.

Lecture schedule:

1. Deterioration in food products and their controls, Physical, chemical and biological methods of food preservation.
2. Dairy development in India, Nutritive value of milk- Engineering, thermal and chemical properties of milk and milk products
3. Classification of milk- market milk and special milks – standardization of milk
4. Unit operation of various dairy and food processing systems
5. Milk reception – milk cans – can washing- cleaning requirements and agents
6. CIP cleaning – components of CIP circuits
7. Pasteurization of milk – HTST and UHT pasteurization
8. Pasteurization process and equipments
9. Sterilization – batch and continuous sterilization
10. In-bottle sterilization- hydrostatic continuous sterilization
11. Hydrolock sterilizer- hot air sterilization
12. Homogenization- Process and equipment
13. Centrifugation and cream separation – process and equipment-
14. Creaming efficiency- flow rate and power requirement
15. Preparation methods and equipment for manufacture of cheese and paneer,
16. Preparation methods and equipment for manufacture of butter
17. Preparation methods and equipment for manufacture of ice cream – overrun in ice cream
18. Filling and packaging of milk and milk products –filling by metering
19. Aseptic processing and packaging – combiblock, Zupack and Tetrabrick systems.
20. Midterm Examination
21. Location of dairy plant- layout – types of dairy plant layout
22. Plant utilities – steam, refrigeration, water, electricity requirements
23. Evaporation of food products – single effect evaporation
24. Multiple effect evaporation
25. Changes in food products during evaporation- Heat and mass balance in evaporators
26. Types of evaporators- steam economy
27. Vapour recompression
28. Drying of liquid and perishable foods: principles of drying
29. Drum drying – equipment
30. Spray drying – classification – equipment – Properties of dried milk
31. Freeze drying – theory- freeze dryer
32. Filtration: principle, - filtration media- filter resistance
33. Constant rate and constant pressure filtration- filtration equipment

34. Membrane separation – membrane configuration- types of membranes
35. RO, Nano-filtration, Ultra filtration and Macro-filtration, equipment and applications
36. Nanotechnology: fundamental concepts

Practical schedule:

1. Study of pasteurizers
2. Study of sterilizers
3. Study of homogenizers
4. Study of separators- cream separation
5. Study of butter churns
6. Study of evaporators
7. Study of milk dryers – drum dryer
8. Study of milk dryers – Spray dryer
9. Study of freezers -Ice cream freezer
10. Study of filtration – constant rate
11. Constant pressure filtration
12. Design of food processing plants & preparation of layout
13. Study of milk packaging machines
14. Study of milk filling machines
15. Estimation of refrigeration requirements in dairy & food plant
16. Estimation of steam requirements
17. Visit to Dairy industry
18. Final Practical Examination

Suggested Readings

1. Ahmed, T. 1997. Dairy Plant Engineering and Management. 4th Ed. Kitab Mahal.
2. McCabe, W.L. and Smith, J. C. 1999. Unit Operations of Chemical Engineering. McGraw Hill.
3. Rao, D.G. 2010. Fundamentals of Food Engineering. PHI learning Pvt. Ltd. New Delhi.
4. Singh, R.P. & Heldman, D.R. 1993. Introduction to Food Engineering. Academic Press.
5. Toledo, R. T. 1997. Fundamentals of Food Process Engineering. CBS Publisher.
6. Tufail Ahmed, “Dairy Plant Engineering and Management”, CBS Publishers and Distributors, New Delhi, 2001.

Department of Food and Agricultural Process Engineering-Electives

Elfa 4201. Food Quality and Safety 3(2+1)

Objective

To acquaint and equip the students with the latest standards to maintain food quality as well as to study food laws and regulations,, FSSAI and HACCP protocol.

Theory

Module I (7 hours)

Basics of Food Science and Food Analysis, Concept, objectives and need of food quality. Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition.

Module II (11 hours)

Sampling; purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials, Quality control, Quality control to ols, Statistical quality control, Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality.

Module III (8 hours)

Food adulteration and food safety. TQM and TQC, consumer preferences and acceptance, Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point).

Module IV (9 hours)

Sanitation in food industry (SSOP), Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series. CAC (Codex Alimentarius Commission), Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism.

Practical

Examination of cereals & pulses from one of go-downs and market shops in relation to FPO and BIS specifications, Detection of adulteration and examination of ghee for various standards of AGMARK & BIS standards, Detection of adulteration and examination of spices for AGMARK and BIS standards, Detection of adulteration and examination of milk and milk products for BIS standards, Detection of adulteration and examination of fruit products such as jams, jellies, marmalades for FPO specification, Visit to quality control laboratory, Case study of statistical process control in food processing industry, Study of registration process and licensing procedure under FSSAI, Study of sampling techniques from food processing establishments, Visit to food processing laboratory and study of records and reports maintained by food processing laboratory.

Lecture Schedule

1. Food safety- need for quality control and safety.
2. Basics of Food Science and Food Analysis, Concept, objectives and need of food quality.

3. Strategy and criteria for food safety - microbiological criteria for safety and quality.
4. Sources of microorganisms for food spoilage
5. Food spoilage food borne diseases and their control.
6. Measurement of colour, flavour, consistency, and their relationship with food safety and quality aspects
7. Measurement of texture, viscosity and their relationship with food quality food safety and quality aspects
8. Food safety- sampling plans and criteria for microbial assessments in foods.
9. Sampling- purpose, sampling techniques, sampling procedures for liquid.
10. Sampling procedures for powdered and granular materials.
11. Food contaminants – physical, biological and chemical contaminants
12. Factors affecting toxicity of compounds- quality control and food safety.
13. Quality control, Quality control tools
14. Statistical tool for quality control, methods of quality control
15. Sensory evaluation methods, panel selection methods
16. Interpretation of sensory results.
17. Instrumental method for testing quality.
18. Personnel hygienic standards.
19. Food adulteration and food safety.
20. Midterm Examination
21. TQM and TQC, consumer preferences and acceptance,
22. Food Safety Management Systems GAP, GHP, influence on food processing industry
23. Food Safety Management Systems GMP-influence on food processing industry
24. Hazards and HACCP (Hazard analysis and critical control point)- principles.
25. Preparation of HACCP plan, Development of HACCP plan for food industries
26. Sanitation in food industry (SSOP) - principles
27. SSOP- applications in food industry
28. Food Laws and Regulations in India- FSSAI,
29. Food Laws and Regulations in India- FSSAI,
30. National standards – FPO and PFA standards for food products
31. National standards – AGMARK and BIS standards for food products
32. International standards - ISO 9001 and ISO 22,000 standards
33. International standards -FPEDA, CFR
34. Codex Alimentarius Commission Standards
35. Traceability and Quality Assurance system in a process plant,
36. Bio safety and Bioterrorism.

Practical Schedule

1. Examination of cereals & pulses from one of go-downs in relation to FPO and BIS specifications
2. Examination of cereals & pulses from one of market shops in relation to FPO and BIS specifications

3. Detection of adulteration and examination of ghee for various standards of AGMARK & BIS standards
4. Detection of adulteration and examination of common food product
5. Detection of adulteration and examination of spices for AGMARK standards
6. Detection of adulteration and examination of spices for BIS standards
7. Detection of adulteration and examination of milk and milk products for BIS standards,
8. Detection of adulteration and examination of fruit products such as jams, jellies, for FPO specification
9. Detection of adulteration and examination of fruit products such as squash, marmalades for FPO specification,
10. Visit to quality control laboratory,
11. Case study of statistical process control in food processing industry,
12. Case study of statistical process control in food processing industry,
13. Study of registration process and licensing procedure under FSSAI
14. Study of FSSAI functions
15. Study of sampling techniques from food processing establishments,
16. Visit to food processing laboratory
17. Study of records and reports maintained by food processing laboratory.
18. Final Practical examination

Suggested Readings

1. Dean, J.W. and J.R.Evans, (1994). Total Quality. West Publishing company, New York.
2. Frazier, W.C and D.C. Westhoff. (1978). Food microbiology. Tata Mc Graw Hill Publishing Co. Ltd. New Delhi. 540pp.
3. Hobbs. B.C and R.J. Gilbert. (1982). Food Poisoning and food hygiene., The English Language Book Society and Edward Arnold Publishers Ltd., London.
4. Luning, P.A, W.J.Marcelis and W.M.F. Jongen, (2002). Food quality management: A technomanagerial approach, Wageningen press, ISBN 9074134815, Wageningen, The Netherlands, 323 pp.
5. Luning. P.A., F. Devlieghere and R. Verhe, (2007). Safety in the agri- food chain, Wageningen academic publishers

Elfa 4202. Food Plant Design and Management 3 (2+1)

Objective

To acquaint and equip the students with the design features of different food processing equipments used in the food industries and also to give an idea about the plant layout.

Theory

Module I

(6 hours)

Food plant location, selection criteria, Selection of processes, plant capacity, Requirements of plant building and its components, Project design, flow diagrams, selection of equipment, process and controls, Objectives and principles of food plant layout.

Module II (10 hours)

Salient features of processing plants for cereals, pulses, oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products. Introduction to Finance, Food Product Marketing, Food Business Analysis and Strategic Planning.

Module III (13 hours)

Introduction to Marketing, Food Marketing Management, Supply chain management for retail food products, Entrepreneurship development in food industry, SWOT analysis, generation, incubation and commercialization of ideas and innovations, New product development process,

Module IV (6 hours)

Government schemes and incentive for promotion of entrepreneurship, Govt. policy on small and medium scale food processing enterprise, export and import policies relevant to food processing sector, procedure of obtaining license and registration under FSSAI, Cost analysis and preparation of feasibility report.

Practical

Preparation of project report, Preparation of feasibility report, Salient features and layout of pre processing house, Salient features and layout of Milk and Milk product plants, Evaluation of given layout, Salient features, design and layout of modern rice mill, Salient features, design and layout of Bakery and related product plant, Study of different types of records relating to production of a food plant, Study of different types of records relating to finance of a food plant, Study of different types of records relating to marketing of a food business, Brain storming and SWOT analysis to start a food processing business.

Lecture Schedule

1. Food plant location, selection criteria- plant location, location theory and models
2. Selection of processes, plant capacity, different criteria for plant site selection
3. Plant layout objectives-classical and practical layout
4. Types of plant layout –process, product and layout
5. Fixed position and combination layout
6. Development and presentation of the layout - objectives and principles of food plant layout
7. Requirements of plant building and its components for food processing units
8. Project design, flow diagrams, selection of equipment, process and controls
9. Project design, flow diagrams, selection of equipment, process and controls
10. Preparation of layout for fruit processing industry
11. Preparation of layout for vegetable processing industry
12. Salient features of processing plants for cereals, pulses
13. Salient features of processing plants for oilseeds
14. Salient features of processing plants for poultry, fish and meat products
15. Salient features of processing plants for milk and milk products.
16. Introduction to Finance, -Financial management for food processing units
17. Introduction to Marketing, -consumer behavior and market segmentation
18. Product mix-product brand-product life cycle

19. Channels of distribution-sales promotion of food products
20. Advertising-advertising media for small food processing industries
21. Midterm Examination
22. Personal selling-marketing research
23. Food Marketing Management
24. Management information systems in agro-food processing units
25. Food Business Analysis and Strategic Planning
26. Supply chain management for retail food products
27. Entrepreneurship development in food industry – implementation of business plans
28. SWOT analysis, generation, incubation of agro-food processing units
29. Commercialization of ideas and innovations – development of small scale food processing unit
30. New product development process, implementation – steps involved in product development
31. Government schemes and incentive for promotion of entrepreneurship, Govt. policy on small and medium scale food processing enterprise
32. Export and import policies relevant to food processing sector
33. Export and import policies relevant to food processing sector
34. Procedure of obtaining license and registration under FSSAI, functions and use of FSSAI
35. Cost analysis and preparation of feasibility report for food processing industries
36. Prospects of agro food processing industries in the emerging economic scenario

Practical Schedule

1. Preparation of project report.
2. Preparation of feasibility report.
3. Salient features and layout of pre-processing house.
4. Salient features and layout of Milk and Milk product plants
5. Evaluation of given layout.
6. Salient features, design and layout of modern rice mill.
7. Salient features, design and layout of fruit processing unit.
8. Salient features, design and layout of canning unit.
9. Salient features, design and layout of Bakery and related product plant
10. Study of different types of records relating to production of a food plant
11. Study of different types of records relating to finance of a food plant
12. Study of different types of records relating to marketing of a food business
13. Brain storming on Agri business opportunity
14. SWOT analysis to start a food processing business.
15. Preparation of business proposal for small scale industry
16. Preparation of business proposal for small scale industry
17. Visit to small scale industry
18. Final Practical examination

Suggested Readings

1. Lopez Antonio. Gomez. 2005. Food Plant Design.
2. James, M. More. 1976. Plant Layout and Design. MacMillian Publishing Co., New York.
3. Geankoplis, C. J. 1997. Transport processes and Unit operations, Prentice Hall of India Publication, New Delhi
4. Jowitt, R. (Ed.), 1980. Hygienic Design and Operation of Food Plant. Ellis Horwood, Chichester.
5. Slade, F. H. 1967. Food processing plant. Leonardhill Books, London.

Elfa 4203. Food Packaging Technology 3 (2+1)

Objectives

To acquaint and equip the students with different packaging materials, methods of packaging, packaging technology and packaging machineries used in food industry.

Theory

Module I

(7 hours)

Factors affecting shelf life of food material during storage, Interactions of spoilage agents with environmental factors as water, oxygen, light, pH, etc. and general principles of control of the spoilage agents; Difference between food infection, food intoxication and allergy. Packaging of foods, requirement, importance and scope, frame work of packaging strategy, environmental considerations, Packaging systems, types: flexible and rigid; retail and bulk; levels of packaging; special solutions and packaging machines, technical packaging systems and data management packaging systems,

Module II

(11 hours)

Different types of packaging materials, their key properties and applications, Metal cans, manufacture of two piece and three piece cans, Plastic packaging, different types of polymers used in food packaging and their barrier properties. manufacture of plastic packaging materials, profile extrusion, blown film/ sheet extrusion, blow molding, extrusion blow molding, injection blow molding, stretch blow molding, injection molding. Glass containers, types of glass used in food packaging, manufacture of glass and glass containers, closures for glass containers. Paper and paper board packaging, paper and paper board manufacture process, modification of barrier properties and characteristics of paper/ boards. Relative advantages and disadvantages of different packaging materials; effect of these materials on packed commodities Nutritional labelling on packages

Module III

(10 hours)

CAS and MAP, shrink and cling packaging, vacuum and gas packaging; Active packaging, Smart packaging, Packaging requirement for raw and processed foods, and their selection of packaging materials, Factors affecting the choice of packaging materials, Disposal and recycle of packaging waste, Printing and labelling, Lamination.

Module IV

(7 hours)

Package testing: Testing methods for flexible materials, rigid materials and semi rigid materials; Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding

endurance, ply bond test, surface oil absorption test, etc.), plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.), aluminium foil (thickness, pin holes, etc.), glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility, etc.).

Practical

Identification of different types of packaging materials, Determination of tensile/ compressive strength of given material/package, To perform different destructive and non-destructive tests for glass containers, Vacuum packaging of agricultural produces, Determination of tearing strength of paper board, Measurement of thickness of packaging materials, To perform grease-resistance test in plastic pouches, Determination of bursting strength of packaging material, Determination of water-vapour transmission rate, Shrink wrapping of various horticultural produce, Testing of chemical resistance of packaging materials, Determination of drop test of food package and visit to relevant industries.

Lecture schedule

1. Introduction to packaging- application in food industry
2. Factors affecting shelf life of food material during storage-Interactions of spoilage agents with environmental factors as water- oxygen, light, pH.
3. General principles of control of the spoilage agents;
4. Difference between food infection, food intoxication and allergy.
5. Packaging of foods-requirement-importance and scope- frame work of packaging strategy-environmental considerations-
6. Packaging systems- types- flexible and rigid- retail and bulk- levels of packaging- special solutions and packaging machines.
7. Packaging systems-technical packaging systems and data management packaging systems,
8. Different types of packaging materials- key properties- applications
9. Metal cans- types.
10. Metal cans- manufacture of two piece and three piece cans
11. Plastic packaging- different types of polymers used in food packaging - barrier properties.
12. Manufacture of plastic packaging materials- profile extrusion- blown film/ sheet extrusion- blow molding,
13. Manufacture of plastic packaging materials-extrusion blow molding- injection blow molding- stretch blow molding- injection molding.
14. Glass containers- types of glass used in food packaging
15. Manufacture of glass and glass containers- closures for glass containers.
16. Paper and paper board packaging- paper and paper board manufacture process
17. Modification of barrier properties - characteristics of paper/ boards.
18. Relative advantages and disadvantages of different packaging materials, Nutritional labelling on packages
19. CAS and MAP

20. Midterm Examination
21. Shrink and cling packaging
22. Vacuum and gas packaging
23. Active packaging- Smart packaging
24. Packaging requirement for raw and processed foods- selection of packaging materials
25. Factors affecting the choice of packaging materials
26. Disposal and recycle of packaging waste
27. Printing of packaging material-types
28. Labelling of packaging material-types
29. Lamination of packaging material-types
30. Package testing- methods for flexible materials- rigid materials and semi rigid materials
31. Package testing -Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test, etc.)
32. Package testing -Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test, etc.)
33. Package testing-plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.), aluminium foil (thickness, pin holes, etc.)
34. Package testing-plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.), aluminium foil (thickness, pin holes, etc.)
35. Package testing-glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility, etc.).
36. Package testing-glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility, etc.).

Practical schedule

1. Identification of different types of packaging materials
2. Determination of tensile/ compressive strength of given material/package
3. To perform different destructive tests for glass containers
4. To perform different non-destructive
5. Vacuum packaging of agricultural produces
6. Modified atmospheric packaging of agricultural produces
7. Study on retort packaging
8. Determination of tearing strength of paper board
9. Measurement of thickness of packaging materials
10. Measurement of grammage of packaging materials
11. To perform grease-resistance test in plastic pouches
12. Determination of bursting strength of packaging material
13. Determination of water-vapour transmission rate
14. Shrink wrapping of various horticultural produce
15. Testing of chemical resistance of packaging materials
16. Determination of drop test of food package
17. Visit to relevant industries.
18. Final Practical examination

Suggested Readings

1. Coles, R., McDowell, D., Kirwan, M .J. (2003). Food Packaging Technology. Blackwell Publishing Co.
2. Gosby, N.T. (2001). Food Packaging Materials. Applied Science Publication
3. John, P.J. (2008). A Handbook on Food Packaging Narendra Publishing House,
4. Mahadevia, M., Gowramma, R.V. (2007). Food Packaging Materials. Tata McGraw Hill
5. Robertson, G. L. (2001). Food Packaging and Shelf life: A Practical Guide. Narendra Publishing House.
6. Robertson, G. L. (2005). Food Packaging: Principles and Practice. Second Edition. Taylor and Francis Pub.

Elfa 4204. Development of Processed Products 3 (2+1)

Objectives

To acquire basic knowledge about food processing and also to study the processing methods of various food materials like fruits & vegetables, dairy products, cereals, meat, poultry, fish and bakery products .

Theory

Module I

(10 hours)

Process design, Process flow chart with mass and energy balance, Unit operations and equipments for processing, New product development, Technology for value added products from cereal, pulses and oil seeds

Module II

(10 hours)

Milling, puffing, flaking, Roasting, Bakery products, snack food. Extruded products, oil extraction and refining, Technology for value added products from fruits, vegetables and spices

Module III

(9 hours)

Canned foods, Frozen foods, dried and fried foods, Fruit juices, Sauce, Sugar based confection, Candy, Fermented food product, spice extracts

Module IV

(6 hours)

Technology for animal produce processing , meat, poultry, fish, egg products, Health food, Nutra-ceuticals and functional food, Organic food.

Practical

Process design and process flow chart preparation, preparation of different value added products, Visit to roller wheat flour milling, rice milling, spice grinding mill, milk plant, dal and oil mill, fruit/vegetable processing plants & study of operations and machinery, Process flow diagram and study of various models of the machines used in a sugar mill.

Lecture schedule

1. Introduction about product development - process design, unit operations
2. Introduction ,equations –Energy balance- importance
3. Numerical approach on energy mass balance

4. Unit operations–various process involved ,definitions-flow charts
5. Different equipments for processing of products.
6. New product development – factors considered.
7. Various value added products from cereals- flow charts
8. Introduction, classification - value added products of pulses- flow chart
9. Introduction, classification - value added products of oil seeds- flow chart
10. Milling – equipments- types -classification of different agriculture products.
11. Milling – equipments- types -classification of different agriculture products.
12. Puffing – flaking – pounding – major ingredients –equipments – flow chart
13. Roasting of different products – equipments - changes in composition.
14. Bakery products – ingredients, its role-baking technology.
15. Snack food- ingredients, its role-processing methods – flow chart
16. Extruded products- ingredients –processing technology.
17. Oil extraction –and refining – methods.
18. Oil extraction –and refining – methods.
19. Introduction, classification - value added products from fruits and vegetables
20. Midterm Examination
21. Introduction, classification - value added products from spices- flow chart
22. Canned foods - processing -advantages and disadvantages.
23. Frozen foods-advantages and disadvantages
24. Dried and fried foods – preparation methods- flow chart-
25. Fruit juices – types : squash, RTS, cordial ,nectar
26. Sauce –ketchup-puree- preparation methods.
27. Sugar based confectioneries – role of ingredients, processing method.
28. Candy, toffee, marzipans – ingredients - preparation –definition - types.
29. Fermented food product – benefits, processing methods.
30. Spice extracts –difference between oleoresins and essential oils- processing methods.
31. Technology for animal produce processing - meat, composition-processing and preservation methods
32. Poultry –composition -processing methods – preservation methods
33. Fish – classification - composition – fish cookery-spoilage-preservation and storage
34. Egg- nutritive value – products and by products.
35. Health food – examples, Nutraceuticals and functional food
36. Overview on organic food – advantages.

Practical Schedule

1. Study based on process design.
2. Process flow chart preparation.
3. Preparation of different value added products – cereals.
4. Preparation of different value added products – confectionery products.
5. Preparation of different value added products-pulses.
6. Preparation of different value added products – extrusion method.
7. Preparation of different value added products – fruits.

8. Preparation of different value added products – vegetables.
9. Study on rice milling machineries.
10. Study on pulse milling machineries
11. Study on spice grinding –hammer mill & cryogenic mill.
12. Preparation of milk based products.
13. Study on dhal and oil mill.
14. Visit to fruit processing plants & study of operations and machinery.
15. Visit to Spice industry & study of operations and machinery.
16. Process flow diagram and study of various models of the machines used in a sugar mill.
17. Visit to roller wheat flour milling.
18. Final Practical examination.

Suggested Readings

1. Achaya, K T (2011) Everyday Indian Processed foods. National Book Trust.
2. Geankoplis C. J.(1997) Transport processes and unit operations, Prentice-Hall.
3. Norman N. (1995) Potter and Joseph H. Hotchikss. Food Science. Chapman and Hall Pub.
4. Rao, D. G.(2010) Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.

Elfa 4205. Process Equipment Design 3 (2+1)

Objectives

To equip the students to study the design aspects of the food processing equipments and also to understand the relationship between process design and safety.

Theory

Module I (8 hours)

Introduction on process equipment design, Application of design engineering for processing equipments, Design parameters and general design procedure. Design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems. Corrosion and protective coatings.

Module II (5 hours)

Material specification, Types of material for process equipments, Design codes, Pressure vessel design, Design of cleaners. Design of pulper, homogingers, crushers and storage vessels: Operating conditions, design conditions and stress, temperature effects, radiation effects, effects of fabrication method

Module III (9 hours)

Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories, Design of heat exchangers: Design of tubular heat exchanger, shell and tube heat exchanger and plate heat exchanger, Design of belt conveyer, screw conveyer and bucket elevator. Design of freezers

Module IV

(13 hours)

Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer, , Design of milling equipments. Optimization of design with respect to process efficiency, energy and cost, Computer Aided Design.

Practical

Design of pressure vessel, cleaners, milling equipments, tubular heat exchanger, shell and tube type heat exchanger, plate heat exchanger, dryer, belt conveyor, bucket elevator, screw conveyor.

Lecture Schedule

1. Introduction and scope of process equipments design, classification of materials properties and mechanical properties
2. Corrosion, corrosion prevention methods for equipment.
3. Protective coatings materials, ductility, hardness
4. Application of Engineering Principles to design and selection of food processing equipments
5. Design of equipment components such as shafts, pulleys, bearings, belts, springs, drives, speed reduction systems
6. Design of equipment components such as shafts, pulleys, bearings, belts, springs, drives, speed reduction systems
7. Construction and design of pressure vessels: storage tank
8. Introduction ,definition and types of design parameters
9. Material codes : definition ,classification, different types and theories failure
10. Definition, classification and types of Material specification and design codes
11. Construction and design of pulping and crushing equipments
12. Construction and design of different types of cleaners and homogenisers
13. Safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations.
14. Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories
15. Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories
16. Construction and design of tubular heat exchanger and plate heat exchanger
17. Construction and design of shell and tube heat exchanger
18. Introduction , definition , types of conveyors and elevators
19. Construction and design of belt conveyer
20. Midterm Examination
21. Construction and design of screw conveyer
22. Construction and design of bucket elevator
23. Freezing, definition, methods and design of freezers
24. Definition , types of dryers and drying methods
25. Construction and design of LSU dryer
26. Design of tray dryer, tunnel dryer and fluidized bed dryer
27. Design of spray dryer, vacuum dryer and microwave dryer
28. Definition ,types and methods of milling equipments, Construction and design of rubber roll Sheller
29. Construction and design of attrition mill and ball mill
30. Construction and design of hammer mill and pin mill

31. Optimization of design with respect to process efficiency
32. Energy and cost economics of different design equipments
33. Introduction ,definition and classification of computer aided design
34. Brief description about computer aided design
35. Numerical discussion about drying methods and milling and conveying methods
36. Numerical discussion about heat exchange methods

Practical Schedule

1. Design and drawing of pressure vessel
2. Design and drawing of different types of cleaners
3. Design and drawing of continuous dryers
4. Design and drawing of Batch dryers
5. Numerical approach on Design of dryers
6. Design and drawing of rubber roll Sheller
7. Design and drawing of hammer and ball mill
8. Design aspects of tubular heat exchanger
9. Design aspects of shell and tube heat exchanger
10. Design aspects of plate heat exchanger
11. Numerical approach on design of heat exchangers
12. Numerical approach on design of heat exchangers
13. Design aspects of belt conveyor
14. Design aspects of bucket elevator
15. Design aspects of screw conveyor.
16. Numerical approach on design of conveyors
17. Computer assisted design of dryer
18. Practical examination

Suggested Readings

1. Brounsel and Young(1993), Process Equipment Design.
2. Geankoplis,C.J.(1997). Transport processes and Unit operations, Prentice Hall of IndiaPublication, New Delhi
3. James,M.More (1976). Plant Layout and Design. MacMillian Publishing Co., New York.
4. Perry, R.H and C.H.Chilton.(1973). Chemical Engineering Hand Book. McGraw Hill, Tokyo.
5. Rao, D. G. (2010) Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.

Elfa 4206 Agricultural By-Product Utilization 3 (2+1)

Objectives

To acquaint and equip the students with the proper utilization of agricultural waste and by-products and also about development of value added products from wastes.

Theory

Module I (8 Hours)

Types, formation and sources of agricultural waste and byproducts; magnitude of waste generation in different food processing industries, waste utilization in various industries, whey utilization from dairy industry, furnace and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette

Module II (9 Hours)

Generation of electricity using surplus biomass, producer gas generation and utilization, waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermin-composting.

Module III (12 Hours)

Thermo and thermochemical conversion of biomass combustion, pyrolysis of biomass, gasification. Production of silica, silicon, ceramic materials, furfural from wastes. Utilization of rice bran.

Module IV (6 Hours)

Production of pulp and paper from biomass. Alcoholic fermentation of biomass, Production of ethanol from molasses.

Practical

Waste characterization:(a)temperature (b)pH (c) solids content (d)turbidity (e)BOD (f)COD, Determination of ash content of agric. Wastes, Determination of unburnt carbon in ash of paddy straw, To study about briquetting of agricultural residues', Estimation of excess air for better combustion of briquettes, To study about extraction of oil from rice bran, To study about waste treatment plant in food industry, To study about utilization of whey, To study about recovery of peel oil, To study about recovery of germ and germ oil from by-product of cereals, Practical on bioconversion of agro-wastes-part 1, Practical on bioconversion of agro-wastes-part 2, Practical on recycling of agro-wastes and by products, Visits to various industries using waste and food by products

Lecture Schedule

1. Agricultural wastes- introduction-types-formation-sources
2. Waste generation in food processing industries-economic product obtained and utilization
3. Whey utilization from dairy industry
4. Combustion of biomass-principles of combustion-parameter affecting combustion-combustion process
5. Combustion of biomass-principles of combustion-parameter affecting combustion-combustion process
6. Furnaces for biomass combustion-horizontal gate inclined slip grate-cyclone furnace
7. Design of furnaces and boilers-efficiency calculation
8. Briquetting- Production of charcoal briquette
9. Biomass- Generation of electricity from biomass-utilization
10. Biomass-generation of Producer gas-utilization
11. Waste treatment and disposal of agricultural waste-introduction-waste treatment methods

12. Design of biogas plants-institutional-community-family size
13. Construction of biogas plants
14. Operation and management of biogas plants
15. Vermi composting-introduction-advantages-concept-preparation
16. Thermo and thermo-chemical conversion of biomass combustion
17. Incineration of solid wastes-design
18. Pyrolysis of biomass-principle-products
19. Gasification of biomass-principle and types
20. Bio chemical and biological reaction of biomass
21. Production of amorphous silica from rice husk-structure and properties
22. Production of silicon from rice husk-structure and properties
23. Ceramic materials from rice husk-introduction-production
24. Furfural from agricultural wastes
25. Structure of furfural and furon derivatives and properties
26. Extraction of oil from rice bran-Soxhelet apparatus
27. Solvent extraction process-refining of rice bran oil
28. Stabilization of rice bran-different types of stabilizers
29. Stabilization of rice bran-different types of stabilizers
30. Production of pulp and paper from biomass-introduction-type, Production of sulphate pulp by kraft process-chemicals used during pulping
31. Manufacture of paper-paper board from agricultural wastes-principals and methods-unit operation in paper production
32. Principles of bio gasification-alcoholic fermentation-principles, fermentation system - batch and continuous fermentation-design of fermentors
33. Design of batch fermentors
34. Design of continuous fermentors
35. Production of ethanol from hemi cellulose materials, molasses

Practical Schedule

1. Waste characterization: (a) temperature(b)pH(c) solids content(d)turbidity(e)BOD(f)COD
2. Waste characterization: (a) temperature(b)pH(c) solids content(d)turbidity(e)BOD(f)COD
3. Determination of ash content of agril. wastes
4. Determination of un burnt carbon in ash of paddy straw
5. To study about briquetting of agricultural residues'
6. Estimation of excess air for better combustion of briquettes
7. Design of cyclone furnace
8. Studies on stabilization of rice bran
9. To study about extraction of oil from rice bran
10. To study about waste treatment plant in food industry
11. To study about utilization of whey
12. To study about recovery of peel oil

13. To study about recovery of germ and germ oil from by-product of cereals
14. Practical on bioconversion of agro-wastes-part 1
15. Practical on bioconversion of agro-wastes-part 2
16. Practical on recycling of agro-wastes and by products
17. Visits to various industries using waste and food by products
18. Final Practical Examination

Suggested Readings

1. Alba S., A.E. Humphery and N.E. Milles. (1973). *Bio Chemical Engineering* (2 ed.).
2. Baily, J.E and D.F. Ollies. (1986). *Bio Chemical Engineering Fundamentals* (2 ed.). Prescott and Dunn Industrial Micro Biology.
3. Chahal, D.S. (1985). *Food, Feed and Fuel from Biomass*. IBH Publishing. Pvt. Ltd. New Delhi.
4. Chakravarty, A. (1989). *Bio Technology and other Alternative Technologies for Utilization of Bio-mass/ Agrl. Wastes*. Oxford & IBH Pub.Co.Pvt Ltd.

Elfa 4207. Emerging Methods of Food Preservation 3(2+1)

Objective

To acquaint the students with the novel and emerging technologies in food preservation so as to keep pace with the recent technological developments which are less, energy and cost intensive, while maintaining quality and safety.

Theory

Module I

(11 hours)

Introduction, type and sources of radiation, dosimetry, mode of action of ionizing radiation – direct and indirect effect, radiation effect on food constituents, dose requirement for different products and regulations.

Module II

(8 hours)

Hurdle technology – Ozone – its role in food industry – generation – application. Pulsed electrified sterilization - application. Pulsed light processing - High pressure technology – application,

Module III

(10 hours)

Oscillating magnetic field sterilization, Ultra sound – application in food industry. Nano Technology: History, tools and techniques nanomaterials, applications in food packaging and products, implications, environmental impact of nanomaterials and their potential effects on global economics, Enzyme Technology: importance and significance, Effect of Enzyme Technology and its application in food industries.

Module IV

(6 hours)

Ohmic heating-fundamentals-UV-sterilization - microwave heating – Microwave assisted process in food processing- Radio Frequency heating- cold plasma technique.

Practical

Study of radiation processes – Application of hurdle concept – study of synthetic production of ozone- study of intermediate moisture foods-pulsed electric field sterilization – study of ultrasound processing- study of application of nano materials in food processing- study of Ohmic heating of food- UV sterilization of food- study of microwave assisted extraction of spice oils – study of enzyme application in food processing. Study of magnetic field processing-Study of pulsed light processing -Study of radio frequency heating of food-Study of cold plasma technique in food processing

Lecture Schedule

1. Introduction, scope of emerging food preservation methods
2. Radiation- sources and types of radiation for food applications
3. Dosimetry - mode of action of ionizing radiation, Radiation effect on food constituents - direct and indirect effect
4. Radiation dose requirement for different products-Regulations involved in the application of radiation-Equipments
5. Hurdle technology – introduction and importance-Different types of hurdles occur in food spoilage-Hurdle effect – examples
6. Homeostasis – multi target preservation- metabolic exhaustion
7. Different types of hazards, physical, chemical and biological hazards.
8. Ozone – introduction and its role in food industry-advantages
9. generation of Ozone and its application
10. Different levels of ozone in preservation
11. Pulsed electric field sterilization – definition and significance-theory
12. Generation of pulsed electric fields- treatment chamber design-
13. Electric field strength- treatment time temperature – pulse geometry-
14. Application of Pulsed electrified sterilization in food industries
15. Pulsed light processing- theory – generation
16. Applications of Pulsed light processing
17. High pressure technology - importance and significance-Theory
18. HPP-equipment Effect of High pressure technology
19. Applications of HPP in food processing
20. Mid-term examination
21. Oscillating magnetic field sterilization- importance and significance- theory
22. Equipments for generation of magnetic field pulses
23. Effect of Oscillating magnetic field sterilization
24. Ultra sound - importance and significance- theory
25. Ultrasonic processing equipments and constructional details
26. Application of ultrasound in food industries.
27. Nano Technology - importance and significance
28. Nano materials - Effect of Nano Technology and its impact in global scenario
29. Application of nano technology in food processing
30. Enzyme Technology- mode of action
31. Importance, significance and applications of enzyme technology in food processing

32. Major enzymes and potential food applications
33. Ohmic , UV, microwave and radio frequency heating of food – theory and applications
34. Ohmic , UV, microwave and radio frequency heating of food – theory and applications
35. Cold plasma technique - fundamentals
36. Applications in food processing.

Practical Schedule:

1. Study of radiation processes
2. Application of hurdle concept
3. Study of ozone application in food processing
4. Study of intermediate moisture foods
5. Pulsed electric field sterilization
6. Study of ultrasound processing
7. Study of application of nano materials in food processing
8. Study of Ohmic heating of food
9. UV sterilization of food
10. Study of microwave assisted extraction of spice oils
11. Study of microwave assisted extraction of food colours
12. Study of enzyme application in food processing.
13. Study of magnetic field processing
14. Study of pulsed light processing
15. Study of radio frequency heating of food
16. Study of cold plasma technique in food processing
17. Visit to food industry
18. Final Practical Examination

Suggested Readings

1. Da-Wen Sun. (2005). Emerging Technologies for Food Processing, Food Science and Technology International, UK
2. Fellows, P.J (2001). Food Processing Technology.
3. Marcus Karel and Daryl B.Lund. (1975)Physical Principles of Food Preservation. Marcel Dekkaer Inc. New York.
4. Peter Zeuthen and Leif Bogh- Sorensen.(2003) Food Preservation Techniques, Wood head Publishing Ltd. Cambridge.

Elfa 4208. Processing of Fish and Marine Products 3 (2+1)

Objectives

To impart basic knowledge in Fish Processing by understanding the basics of Fisheries Science. Also, to acquaint and equip the students with various Fish Processing operations and applications in Sea Food Processing Industries.

Theory

Module I

(12 hours)

Fisheries resources, global and Indian scenario; Types of fish and other marine products; Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish,

spoilage of fish- microbiological, physiological, biochemical; Relationship between chilling and storage life, MAP, general aspects of fish freezing, changes in quality during chilled and frozen storage;

Module II (8 hours)

Principles of canning, effect of heat processing on fish, storage of canned fish, pre-process operations, post-process operations, cannery operations for specific canned products; Fish products: Introduction, fish muscle proteins, surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products;

Module III (8 hours)

Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysates (FPH); Preparation protocols of indigenous products: Fish sauce and paste. Novel methods; Low dose irradiation; High pressure treatment, MAP, vacuum packaging, gas packaging.

Module IV (7 hours)

Oxygen absorbents and CO₂ generators, ethanol vapour generation, hurdle barrier concept, value added fish products, packaging; Sea food quality assurance, HACCP, EU hygienic regulations and ISO 9000 standards; New kinds of quality and safety problems emerging in sea food processing and preservation.

Practical

Study of anatomy and dressing of fish; Study of anatomy and dressing of prawn and other marine products; Identification of different types of fish - Selection and grading; Identification of different types of prawn and other marine products - Selection and grading; Quality evaluation of fish; Preparation of sun dried and salt cured fish, fish sauce; Chilling and freezing of fish; Preparations of fish protein concentrate; Preparation of fish meal; Preparation of marine fish oils and various fish products; Utilization of fish by-products; Preparation of marine algal products; Preservation of fish: Drying, pickling; Preservation of marine products using fermentation process; Preparation of value added sea products: Cutlets, bullets, wafers; Processing of fish oils; Canning methods for marine fishery products; Estimation of TVB and TMA; Determination of iodine value; Protein estimation by Folin-Lowrey's method; Visit to fish and prawn processing industry.

Lecture Schedule

1. Introduction ,Fisheries resources, global and Indian scenario;
2. Types of fish and other marine products;Classification of fish (fresh water ,brackish and marine),
3. Composition of fish, characteristics of fresh fish,
4. Fish as a Food- advantages of fish as a food.
5. Preservation methods of Fish .
6. Curing of Fish –Smoking,Briningetc.
7. Drying
8. Freezing and Freezers.
9. Cold storage.
10. Changes in quality during chilled and frozen storage.

11. Spoilage of fish- microbiological, Physiological spoilage of Fish.Biochemical spoilage of Fish.
12. Chilling of fish Relationship between chilling and storage life, general aspects of fish freezing.
13. Principles of canning, storage of canned fish.
14. Thermal Processing -effect of heat processing on fish.
15. Canning of Tuna,Mackeral and Sardine.
16. Pre-process operations, post-process operations, cannery operations for specific canned products; Fish products
17. Fish products: Introduction, fish muscle proteins,
18. Surimi process, traditional and modern surimi production lines.
19. Quality of surimi products, comparison of surimi
20. Mid semester Examination.
21. Minced Fish products;
22. Fish protein concentrates (FPC),
23. Fish protein extracts (FPE), fish protein hydrolysates (FPH);
24. Preparation protocols of indigenous products:
25. Fish sauce and paste.
26. Novel methods of Fish Preservation
27. Irradiation of Fish.
28. High pressure treatment,
29. MAP and Vacuum packaging,
30. Gas packaging; Oxygen absorbents and CO₂ generators, ethanol vapour generation, hurdle barrier concept,
31. Value added Fish products
32. Preparation of value added sea products: Cutlets, bullets, wafers;
33. Fish Oil : Extraction of fish oil and uses of fish oil.
34. HACCP : Principles of HACCP
35. EU hygienic regulations and ISO 9000 standards;
36. New kinds of quality and safety problems emerging in sea food processing and preservation.

Practical Schedule

1. Identification of different types of prawn and other marine products .
2. Identification of different types of fish .
3. Study on Processing of fish oils.
4. Study on algal products.
5. Fish Drying experiments.
6. Fish Pickling experiments.
7. Preservation of marine products using fermentation process.
8. Preparation of value added sea products.
9. Preparation of fish Cutlets.
10. Canning methods for marine fishery products.

11. Estimation of TVB .
12. Estimation of TMA.
13. Determination of Iodine value.
14. Protein estimation by Folin-Lowrey's method.
15. Site selection parameters of a Fish Processing Plant.
16. Design of a Fish processing plant.
17. Visit to fish and prawn processing industry.
18. Final Practical Examination

Suggested Reading

1. Brend W. Rautenstrauss and Thomas Liehr. (2002). Fish Technology. Springer-Verlag, US.
2. Brigitte Maas-van Berkel, Brigiet van den Boogaard and CorlienHeijnen. (2004). Preservation of Fish and Meat. Agromisa Foundation, Wageningen.
3. C.O. Chichester and H.D. Graham. (1973). Microbial safety of Fishery products. Academic Press, New York.
4. D.P. Sen. (2005).Advances in Fish Processing Technology. Allied Publishers Pvt. Ltd., Delhi.
5. FAO. (2003). Code of Practices of Canned Fishery products. FAO, UN, Rome.
6. G.M. Hall. (1997). Fish Processing Technology, 2nd Ed. Chapman & Hall, London, UK.
7. K. Gopakumar. (2002).Textbook of Fish Processing Technology. ICAR, New Delhi.

Elfa 4209. Processing of Spices and Plantation Crops 3(2+1)

Objectives

To understand the processing steps involved for different plantation products, spices and aromatic and medicinal plants.

Theory

Module I

(9 hours)

Status of production, Processing and Utilization, Domestic and international demand of plantation crops, Processing of Tea, coffee and cocoa and its by-product utilisation, including the processes and equipments.

Module II

(13 hours)

Status of production, Processing, Domestic and international demand, by-product utilisation and processing equipments of coconut, arecanut, rubber, cashew nut and oil palm.

Module III

(9 hours)

Processing of spices and condiments: Pepper, cardamom, clove, ginger, vanilla, turmeric and chillies. Processing of aromatic and medicinal plants like lemon grass, citronella grass, palmarosa, lemon mint, celery, vetivel, cinchona, kacholam, asgand and dill.

Module IV

(4 hours)

Extraction of oleoresins and essential oils from aromatic plants and spices.Packaging and Storage of processed plantation products.Technologies for product diversification and by product utilization.

Practical

Performance evaluation of coconut dehusker, Production and evaluation of activated carbon from coconut shell, Production and evaluation of particle board from coirpith, Study of a colloid mill, Performance evaluation of a cashew nut sheller, Determination of moisture content of spices- Dean stark apparatus , Extraction of essential oil and oleoresin from spices and aromatic plants – clevenger apparatus and soxhlet apparatus, Performance evaluation of a pepper thresher, Performance evaluation of a pepper grader, Performance evaluation of a white pepper decorticator, Visit to a solvent extraction industry and determination of solvent recovery, Visit to various processing industries –tea, coffee and cashew, Visit to a rubber processing unit, Visit to an oil palm processing unit, Practical Examination.

Lecture schedule

1. Status of production, Processing and Utilization of plantation crops
2. Plantation crops-classification-production & processing-Status and Exports-Domestic and international demand of plantation crops
3. Processing of Tea-unit operation-flow chart, process and equipment
4. Processing of Tea-unit operation-flow chart, process and equipment
5. Processing of coffee-Dry and wet processing-
6. Green, cherry Coffee and Instant coffee powder
7. Coffee -Unit operation-flow charts-equipments and operation of coffee and its by-products
8. Processing of Cocoa-Important unit operation
9. Flow charts in cocoa processing-Equipments-Chocolate processing-flow charts
10. Coconut -introduction ,production-processing-postharvest methods
11. Coconut -Different products-unit operation-flow chart ,equipment and operation
12. Coconut-by-products-uses
13. Arecanut- -introduction ,production ,postharvest methods, Processing
14. Arecanut-Different products-unit operation-flow chart ,equipment and operation
15. Cashew nut- introduction ,production ,postharvest methods-Processing
16. Cashew nut -unit operations-flow chart, equipment and processing methods of cashew nut
17. Processing of cashew apple- by-product utilisation of cashew industry
18. Processing of rubber - introduction ,production ,postharvest methods
19. Rubber -unit operations-flow chart, equipment and processing methods of rubber
20. Midterm Examination
21. Processing of oil palm - introduction ,production ,postharvest methods
22. Oil palm -unit operations-flow chart, equipment and processing methods of oil palm
23. Refining of oil from crude oil palm and packaging
24. Status of production, Processing and Utilization of spices
25. Flavor extraction methods from spices-minor spices and major spices
26. Processing of pepper- value added products-flow chart-packaging methods.

27. Processing of cardamom & Clove- stages of harvest-cleaning, drying, grading equipments.
28. Processing and utilization of Minor spices-herbs, leaves and spartan seasonings
29. Processing of Ginger -flow chart-various products, Processing of chilli- drying-dryers, value added products.
30. Processing of turmeric- boiling and polishing-drying methods-equipments and operation
31. Processing of vanilla and annatto-flowchart, utilization
32. Processing of medicinal plants –flow chart, utilization, methods and unit operations
33. Grinding of spices- problems- cryogenic grinding, Extraction of oleoresins and essential oils from aromatic plants and spices
34. Hydro-distillation- steam distillation – micro assisted distillation of major spices
35. Packaging of processed products -materials- methods-packaging equipments-types – construction and operation and Storage of processed plantation products
36. Packaging of processed products -materials- methods-packaging equipments-types – construction and operation and Storage of processed plantation products

Practical schedule:

1. Experiment on Performance evaluation of coconut dehusker
2. Experiment on Production and evaluation of activated carbon from coconut shell
3. Experiment on Production and evaluation of particle board from coirpith
4. Experiment on Performance evaluation of a cashew nut Sheller
5. Experiment on colloid mill
6. Determination of moisture content of spices- Dean stark apparatus
7. Extraction of essential oil and oleoresin from spices - Clevenger apparatus
8. Extraction of essential oil and oleoresin from aromatic plants - soxhlet apparatus
9. Studies on steam distillation apparatus
10. Performance evaluation of a pepper thresher,
11. Experiment on Performance evaluation of a pepper grader,
12. Experiment on Performance evaluation of a white pepper decorticator
13. Packaging study of spices ,aromatic plants and medicinal plants
14. Visit to a solvent extraction industry and determination of solvent recovery
15. Visit to various processing industries –tea, coffee and cashew
16. Visit to a rubber processing unit,
17. Visit to an oil palm processing unit,
18. Practical Examination

Suggested Reading

1. Kumar N. , Abdul Khadeer , Rangaswami P. Irulappan I.(1995), Introduction to Spices , Plantation crops, Medicinal and aromatic Plants; IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Mulky, M.J., Sharma V.S. (1995). Tea, Culture, Processing and Marketing., IBH Publishing Co. Pvt. Ltd., New Delhi.

3. Pruthi J.S.(1993). Major Spices in India – Crop Management and Post Harvest Technology, Publication and Information division –I.C.A.R. New Delhi.
4. Pursglove J.W. , Brown E.G. , Green C.L. , Robbins S.R.J.(1981). Spices Vol. I & II; Long man Scientific and Technical,. New York

Department of Supportive and Allied Courses of Studies

Sacs.1101 Engineering Mathematics-I 3(2+1)

Objectives

- Differential equations are very useful when several of the factors of a problem are known and several unknowns.
- Calculus is used to determine the rates of change or rates by which factors, such as acceleration or weight, change.
- To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering

Theory

Module I (12 Hours)

Differential calculus: Taylor's and Maclaurin's expansions, indeterminate form; asymptotes, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, derivative of an implicit function, change of variables, Jacobians, maxima and minima. Integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration.

Module II (3 Hours)

Ordinary differential equations: Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation.

Module III (13 Hours)

Differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel's and Legendre's differential equations.

Module IV (8 Hours)

Vector calculus: Differentiation of vectors, scalar and vector point functions, vector differential operator Del, Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, identities involving Del, second order differential operator; Line, surface and volume integrals, Stoke's, divergence and Green's theorems(without proof.)

Practical

Indeterminate forms, Asymptotes, Function of two or more variables, Partial differentiation, homogeneous functions and Euler's theorem, composite functions. Total derivatives, Change of variables, Jacobians. Integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration. Equations reducible to exact form by integrating factors. Methods of finding complementary function and particular integrals. Method of variation of parameters. Cauchy's and Legendre's linear equations. Bessel's equation. Legendre's differential equations. Differentiation of vectors, Scalar and vector point functions, Gradient of a scalar point function. Divergence and curl of a vector point function and their physical interpretations. Identities involving Del, line integrals, Surface integrals. Green's theorem. Stoke's theorem for surface integrals. Volume integrals, Gauss divergence theorem, Green's theorems (without proof).

Lecture schedule

1. Taylor's and Maclaurin's expansions
2. Indeterminate forms
3. Asymptotes
4. Tracing of curves, Cartesian curves.
5. polar curves.
6. Function of two or more variables, Partial differentiation
7. Homogeneous functions and Euler's theorem.
8. Composite functions.
9. Total derivatives.
10. Change of variables.
11. Jacobians.
12. Maxima and minima of functions of more than one variable
13. Linear and Bernoulli's differential equations
14. Equations reducible to exact form by integrating factors
15. Equations reducible to exact form by integrating factors, Clairaut's equation
16. Methods of finding complementary function and particular integrals
17. Methods of finding complementary function and particular integrals
18. Method of variation of parameters
19. Method of variation of parameters
20. Mid examination.
21. Cauchy's and Legendre's linear equations
22. Simultaneous linear differential equations with constant coefficients
23. Simultaneous linear differential equations with constant coefficients
24. Bessel's equation.
25. Recurrence formula, value of $J_{\frac{1}{2}}$
26. Legendre's differential equations
27. Rodrigue's formula.
28. Recurrence formula.
29. Differentiation of vectors, Scalar and vector point functions.
30. Gradient of a scalar point function
31. Divergence and curl of a vector point function and their physical interpretations
32. Identities involving Del
33. Line integrals, Surface integrals
34. Green's theorem .
35. Stocke's theorem for surface integrals.
36. Volume integrals, Gauss divergence theorem, Green's theorems (without proof).

Practical schedule

1. Indeterminate forms, Asymptotes.
2. Function of two or more variables, Partial differentiation, homogeneous functions and Euler's theorem, composite functions.
3. Total derivatives, Change of variables, Jacobians.
4. Integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration.
5. Equations reducible to exact form by integrating factors
6. Methods of finding complementary function and particular integrals

7. Method of variation of parameters.
8. Cauchy's and Legendre's linear equations.
9. Bessel's equation.
10. Legendre's differential equations.
11. Differentiation of vectors, Scalar and vector point functions, Gradient of a scalar point function.
12. Divergence and curl of a vector point function and their physical interpretations
13. Identities involving Del, line integrals.
14. Surface integrals
15. Green's theorem
16. Stoke's theorem for surface integrals.
17. Volume integrals, Gauss divergence theorem, Green's theorems (without proof)
18. Practical examination.

Suggested Reading

- B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
 Shanti Narayan. 2004. Differential Calculus. S. Chand and Co. Ltd., New Delhi.
 Shanti Narayan. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.
 Shanti Narayan. 2004. A Textbook of Vector Calculus. S. Chand and Co. Ltd. New Delhi.

Sacs. 1102 Engineering Physics 3(2+1)

Objectives

- To apply the concepts of physics in solving engineering problems and to understand the general scientific concepts required for technology.
- To understand the concept of magnetism and application of different types of magnets in various disciplines.
- To know the property of semiconductor materials by projecting the view of energy bands and analyzing the characteristics of semiconductor components like various diodes.
- To understand the principle of working of laser and its industrial and scientific applications.
- To understand the structure of optical fibre, propagation mechanisms, its loss through the fibre and its industrial applications.
- To understand the Application of concepts of nano-science in technology and study the drastic change in the properties of nano sized materials.

Theory

Module I

(6 Hours)

Interference in Thin Films, Interference in thin film by reflected light and transmitted light, interference filters, Newton's rings, Newton's Rings in transmitted and reflected light Dia, Para and ferromagnetism-classification. Langevin theory of dia and para magnetism- a brief note, Qualitative explanation of Zeeman effect, Stark effect and Paschan Back effect, Raman spectroscopy.

Module II

(14 Hours)

Energy Bands iii solids, Distinction between metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, law of mass action. Determination of energy gap in semiconductors. Donors and acceptor levels. Superconductivity, critical magnetic

field. Meissner effect. Isotope effect. Type-I and II superconductors, Josephson's effect DC and AC, Squids. Introduction to high T_c superconductors.

Module III

(6 Hours)

LASERS, Spontaneous and stimulated emission, Einstein A and B coefficients. Population inversion, He-Ne and Ruby lasers. Ammonia and Ruby masers, Holography-Note. Recording and Reconstruction of a Hologram, Applications

Module IV

(10 Hours)

Optical fiber. Physical structure. basic theory. Mode type, input output characteristics of optical fiber and applications. Nanotechnology, Nanoscale materials, nano sensors, nano devices, nano drug delivery systems, Applications in agriculture.

Practical

To study the wavelength of light using Newton's Rings,. Newton's Rings Refractive Index, Fresnel's Biprism for determining wavelength of light,. To determine the energy band gap in a semiconductor using a p-n Junction diode.. To determine the slit width from Fraunhofer diffraction pattern using laser beam, To set up the fiber optic analog and digital link, To find the wave length of light by prism, To study the refractive index of the material of the prism using spectrometer, Spectrometer-i-d curve, Spectrometer-i-for d, To study the dispersive power using spectrometer, Diffraction grating normal incidence method, Diffraction grating Minimum deviation, Diffraction grating-oblique incidence, To find the frequency of A C supply using an electrical vibrator, To determine the To find the numerical aperture of optical fiber: To set up the fiber optic analog and digital link, To study the variations of thermo emf of a copper-constantan thermo-couple with temperature.

Lecture Schedule

1. Interference in thin films-reflected light-transmitted light-condition for brightness & darkness.
2. Interference filters-applications of thin film interference.
3. Newton's rings- Experimental arrangement-condition for bright and dark fringe-Dark central spot-circular fringes.
4. Radii of circular fringes-fringes of equal thickness.-determination of wavelength of light-Determination of refractive index of liquid.
5. Diffraction, Fresnel & Fraunhofer diffraction, Diffraction Grating.
6. Determination of wavelength of light by diffraction grating.
7. Dia-magnetism- classical and quantum theory- para magnetism-Langevin theory of Dia and Para-magnetism.
8. Ferromagnetism- statement of curie-Weiss law-curie point-ferromagnetic domains-ferrites.
9. Anti-ferro magnetism-domain wall-hard and soft magnetic materials.
10. Zeeman effect-definition-normal and anomalous Zeeman effect.
11. Stark effect-explanation.
12. Nuclear magnetic resonance-NMR spectrometer.
13. Paschen back effect-explanation of energy levels.

14. Raman effect-classical and quantum theory- applications.
15. Distinction between metals semiconductors and insulators-intrinsic and extrinsic semiconductors-donor and acceptor levels.
16. Superconductivity-effect of applied magnetic field-persistent current.
17. Meissner effect-London equation-London penetration depth.
18. Thermodynamics of superconducting phase transition-entropy-specific heat capacity.
19. Energy gap-isotope effect-BCS theory-cooper pair-.type I and type ii superconductor.
20. Mid Examination.
21. Josephson effect-AC and DC Josephson effect-Josephson tunneling.
22. High temp superconductors-SQUIDS-Josephson junction switch-applications.
23. Lasers-spontaneous and stimulated emissions-population inversion-coherence –spatial and temporal coherence.
24. Bandwidth-laser broadening-natural-collisional – doppler broadening.
25. Ruby laser-He-Ne laser-NdYag laser-Co₂ laser-PN junction diode laser.
26. Holography –hologram-recording-reconstruction of hologram-applications.
27. Optical fibers-numerical aperture-acceptance angle-modes-single and multimode.
28. Step index and graded index fibers-intermodal dispersion-fiber optic communication-applications.
29. History, definition, terminology in nano-science and importance of moors law.
30. Nanomaterials-biosensors-principle-components-types-applications.
31. Synthesis of nonmaterial-top down and bottom up approach.
32. Properties and characterization-optical and electrical properties of nano materials.
33. Nano tech equipments.
34. Applications of nano technology-nano fertilizer-nano-herbicides-nano pesticides
35. Nano packaging-nano-encapsulation-
36. Nano technology in food systems-nano foods- socio-economic and ethical issues in nano tech and nano toxicology.

Practical schedule

1. To study the wavelength of light using Newton's Rings
2. Newton's Rings Refractive Index
3. Fresnel's Biprism for determining wavelength of light
4. To determine the energy band gap in a semiconductor using a p-n Junction diode
5. To determine the slit width from Fraunhofer diffraction pattern using laser beam
6. To find the numerical aperture of optical fiber

7. To set up the fiber optic analog and digital link.
8. To find the wave length of light by prism
9. To study the refractive index of the material of the prism using spectrometer
10. Spectrometer-i-d curve
11. Spectrometer-i-for d .
12. To study the dispersive power using spectrometer
13. Diffraction grating normal incidence method
14. Diffraction grating Minimum deviation.
15. Diffraction grating-oblique incidence
16. To find the frequency of A C supply using an electrical vibrator
17. To study the variations of thermo emf of a copper-constantan thermo-couple with temperature.
18. Practical Examination.

Suggested Reading

- Brijlal and Subrahmanyam. Text Book of optics. S. Chand and Co., New Delhi.
- Sarkar Subir Kumar. Optical State Physics and Fiber Optics. S. Chand and Co., New Delhi.
- Gupta S L, Kumar V Sharma R C. Elements of Spectroscopy. PragatiPrakasam, Meeruth.
- Saxena B S and Gupta R C. Solid State Physics. PragatiPrakasam, Meeruth.
- Srivastava B N. Essentials of Quantum Mechanics. PragatiPrakasam, Meeruth.
- Vasudeva D N. Fundamentals of Magnetism and Electricity. S. Chand and Co., New Delhi.
- Nano the essentials understanding nanoscience and nanoT RADDEB 2009 McGraw hill
- Nano materials B Viswanathan 2009 Narosa.
- Nano tech applications in agriculture CR Chinnamuthu , B chadrsseharan and C Ramasamy 2008.

Sacs. 1103 Engineering Chemistry 3(2+1)

Objectives:

- To develop economic ways of using materials and energy, Designing and performing experiments to create new and better ways of production, controlling pollution and conserving resources.
- To turn raw materials into usable products, such as medicine, petrochemicals and plastics on a large-scale, industrial setting.

Theory

Module I

(9Hours)

Water- temporary and permanent hardness, disadvantages of hard water, scale and sludge formation in boilers, boiler corrosion, demineralization, desalination, disinfection of water. Analytical methods -thermogravimetric analysis and polarographic analysis, U.V. Spectra – verification of Beer Lambert’s Law. Chromatography.

Module II

(9Hours)

Fuels - classification, calorific value, Coal- classification, analysis of coal-proximate and ultimate methods. Petroleum, synthesis of petrol, coal gas and biogas. Analysis of flue gas by Orsat apparatus. Colloids- classification, properties.

Module III

(9Hours)

Corrosion- causes, types and method of prevention. Polymers- types of polymerization, properties and uses of different types of high polymers.

Module IV

(9Hours)

Lubricants- classification, properties. Principles of food chemistry-introduction to lipids, proteins, carbohydrates, vitamins, food preservatives, colouring and flavouring reagents of food. Enzymes and their use in the manufacturing of ethanol and acetic acid by fermentation methods.

Practical

Determination of temporary and permanent hardness of water by EDTA method: Estimation of chloride in water: Estimation of dissolved oxygen in water: Determination of BOD in water sample: Determination of COD in water sample: Estimation of available chlorine in bleaching powder: Determination of viscosity of oil: Estimation of activity of water sample: Estimation of alkalinity of water sample: Determination of carbonate and non- carbonate hardness by soda reagent: Determination of coagulation of water and chloride ion content: Determination of specific rotation of an optically active compound: Determination of X_{max} and verification of Beer Lambert Law: Determination of calorific value of fuel: Identification of functional groups (alcohol, aldehyde, ketones, carboxylic acid and amide) by IR: Chromatographic analysis: Determination of molar refraction of organic compounds.

Lecture schedule

1. Sources of water, impurities in water, nature of impurities and their removal.
2. Hardness of water - effect of hardness, determination of hardness.
3. Softening of water - (1)Lime -soda process (2) zeolite method
4. Demineralization, ion exchange method, (1)Process that separate water from salt water - Evaporation/distillation, solvent extraction & reverse osmosis (2) Process that separate salt from saline water - electro dialysis
5. Water treatment - Removal of bacteria and microorganism by sterilization - bleaching power, chlorine, chloramines, ozone and U.V light.
6. Potability of water, Various methods of treatment of industrial waste and radio active waste.
7. Classification of fuels, calorific values, gross and net calorific values - coal - origin and its classification
8. Proximate and ultimate analysis of coal.
9. Petroleum- origin, classification, fractionation of petroleum, refining of petrol, knocking property, octane number, knocking and anti knocking agents.
10. Cracking of petrol, synthesis of petrol- Fischer Tropsch processes& Bergius processes.
11. Gaseous fuels -manufacture, composition and calorific values of coal gas and biogas.
12. Flue gas analysis by Orsat apparatus.
13. Definition, cause of corrosion, types of corrosion, theories of corrosion
14. Galvanic cell corrosion, concentration cell corrosion, pitting corrosion, stress corrosion, dezincification, microbial corrosion, atmospheric corrosion.
15. Control of corrosion - by purification, alloying, cathodic protection, using inhibitors & passivators
16. Protective coating - paint, lacquer, enamel and varnish
17. Types of polymerization, properties and uses of different types of high polymers
18. Plastics- types of plastics, Compounding of plastics

19. Rubber - Natural rubber, synthesis of rubber
20. Mid- Examination
21. Fibers - Natural & synthetic fibers and use of Nylon, Terylene and Rayon
22. Classification, types of lubrication, properties and tests (Viscosity and viscosity index, flash and fire point, cloud and pour point, emulsification)
23. Colloids -classification of colloids,Colloids-Preparation of colloidal solution - Dispersion and Condensation methods-purification.
24. Colloids - Properties of colloidal solution - electrical double layer, Zeta potential – Cataphoresis, Origin of charge on colloidal solutions and application of colloids
25. Chemistry of carbohydrates, classification- mono saccharides, properties of monosaccharides, disaccharides, properties of disaccharides
26. Polysaccharides -properties, cellulose, starch, dextrin, glycogen, gums, pectic substances, hemicellulose.
27. Chemistry of lipids - classification-fat constants and characteristics of fats.
28. Classification of fatty acids, alcohols in fats - properties of fats and fatty acids, simple lipids, phospholipids
29. Chemistry of fat soluble vitamins and water soluble vitamins.Amino acids and proteins.- classification and properties
30. Chemistry of enzymes ,use of enzyme in the manufacture of ethanol and acetic acid by fermentation methods.
31. Thermo gravimetric analysis, Polarographic analysis.
32. Chromatography- principle, types of chromatography.
33. Flavours-important flavour compounds
34. Food preservatives -class I and class II preservatives
35. U.V. Spectra - verification of Beer-Lambert's Law
- 36.Colours –natural and artificial colours.

Practical

1. Determination of temporary hardness of water by EDTA method
2. Determination of permanent hardness of water by EDTA method
3. Estimation of chloride in water
4. Estimation of dissolved oxygen in water
5. Determination of BOD in water sample
6. Determination of COD in water sample
7. Estimation of available chlorine in bleaching powder
8. Estimation of alkalinity of water sample
9. Estimation of acidity of water sample
10. Estimation of iron in water by colourimetry
11. Determination of carbonate and noncarbonated hardness by soda reagent
12. Qualitative test for carbohydrates and proteins
13. Qualitative test for lipids
14. Qualitative test for fats
15. Determination of fat constant – saponification values
16. Estimation of Vitamin C
17. Determination iodine value – acid number
18. Practical Examination

Suggested Readings

- Albert L. Lehninger. *Biochemistry*. Kalyani Publishers, New Delhi.
- B. R. Puri & R.L. Sharma & Pathania. (2004). *Principles of Physical chemistry*. Vishal Publishing Co. Jalandhar.
- Bahl B. S & G.D. Tuli. *Essentials of Physical chemistry*. S. Chand and Co. Ltd.
- Bhatnagar M.S. (1999). *Textbook of Pure and Applied Physical Chemistry*. A.H. Wheeler & Co., New Delhi.
- Grudeep Dr. & Harish. *Advanced Physical Chemistry*. Goel Publishing House, Meerut.
- Hobart H. Willard, Lynna L. Merritt, Jr and John A. Dean. *Instrumental Methods of Analysis*. D. Van Nostrand Company, Inc.
- I.L. F. *Organic Chemistry* (6 ed.). ELBS & Longman.
- Jain J.L., Sanjay Jain, Nitin Jain. (2007). *Fundamentals of Biochemistry*. S. Chand and Company Ltd.
- Khopkar, S.M. *Basic concepts of Analytical Chemistry*. Wiley Eastern Ltd., New Delhi.
- Philip R. Ashurst. *Food flavorings* (3 ed.). An Aspen Publications.
- Raymond Chang. *Basic Principles of Spectroscopy*. Mc Graw-Hill Kogakusha Ltd.
- Shakuntala Many N., M. Shadaksharaswamy. (2000). *Foods - Facts and Principles*. New Age International (P) Ltd.
- Sharma B.K. *Colloidal Chemistry*. Goel Publishing House.
- Sharma, B.K. *Instrumental Methods of Chemical Analysis*. Goel Publishing House, Meerut.
- Uppal M.M. (2001). *A text book of Engineering Chemistry*. Khanna Publishers.
- Vogel, A.I. *A Text Book of Quantitative Inorganic analysis*. ELBS & Longman.
- Vogel, A.I. *Organic Analysis*. ELBS & Longman.

Sacs. 1104 Principles of Soil Science 2(2+0)

Objectives

- To build fundamental knowledge and skills of the students within the different areas of soil science to enhance their professional skills
- To familiarize the students with the origin of soil, different soil forming processes and different soil taxonomy orders
- To identify and describe soil physical, chemical, and biological properties and processes that affect agricultural and non-agricultural land use and management

Theory

Module I

(10 Hours)

Nature and origin of soil; soil forming rocks and minerals, their classification and composition, soil forming processes, classification of soils – soil taxonomy orders.

Module II

(6 Hours)

Important soil physical properties; and their importance; soil particle distribution; soil inorganic colloids – their composition, properties and origin of charge; ion exchange in soil and nutrient availability.

Module III**(15 Hours)**

Soil organic matter – its composition and decomposition, effect on soil fertility; soil reaction – acidic, saline and sodic soils.

Module IV**(5 Hours)**

Quality of irrigation water; Use of saline and sodic water for crop production, Gypsum requirement for reclamation of sodic soils and neutralising RSC; Liquid fertilisers and their solubility and compatibility.

Lecture schedule

1. Soil-definition-nature and origin of soil
2. Weathering process-definition-types
3. Physical weathering-factors affecting physical weathering
4. Chemical weathering-factors affecting chemical weathering
5. Biological weathering-factors
6. Soil forming rocks and minerals, their classification and composition
7. Soil forming factors
8. Soil forming processes
9. Classification of soils – soil taxonomy orders
10. Characteristic features of different orders
11. Important soil physical properties of soil -texture, bulk density
12. Particle density, soil porosity and soil plasticity - their importance
13. Soil particle distribution; soil inorganic colloids
14. Composition and properties of soil inorganic colloids
15. Origin of charge; ion exchange in soil
16. Nutrient availability in soil
17. Soil organic matter – its composition and decomposition
18. Effect of soil organic matter on soil fertility
19. Soil reaction –Acid soils-nature of soil acidity
20. Mid examination
21. Sources and effect of acidity on plant growth
22. Lime requirement of acid soils
23. Management of acid soils
24. Saline soils- genesis, morphology
25. Sodic soils- genesis, morphology
26. Characterization of salt affected soils - soluble salts, ESP, pH
27. Physical and chemical properties of salt affected soils
28. Microbiologicalproperties of salt affected soils
29. Management of salt-affected soils
30. Salt tolerance of crops
31. Biological sickness of soils and its management
32. Quality of irrigation water-criteria.
33. Irrigation water-quality-parameters
34. Classification-management. Use of saline and sodic water for crop production
35. Gypsum requirement for reclamation of sodic soils and neutralizing RSC
36. Liquid fertilizers and their solubility and compatibility

Suggested Reading

- Brady Nyle C and Ray R Well. 2002. Nature and properties of soils. Pearson Education Inc., New Delhi.
- Indian Society of Soil Science. 1998. Fundamentals of Soil Science. IARI, New Delhi.
- SehgalJ.. A. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.
- Hillel D. 1982.Introduction to Soil Physics. Academic Press, London.

Sacs. 1105 Principles of Agronomy 2(2+0)

Objective

To equip the students with necessary theoretical and practical knowhow on basic principles of cropping and acquaint them with the cultivation practice of paddy being the most important crop of Kerala.

Theory

Module I

(6 Hours)

Introduction to agriculture and relevance of the course with respect to agricultural engineers.Introduction and scope of agronomy.Classification of crops, Effect of different weather parameters on crop growth and development.

Module II

(23 Hours)

Principles of tillage, tilth and its characteristics.Crop seasons.Methods, time and depth of sowing of major field crops.Soil fertility; essential plants nutrients – their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils.Methods and time of application of manures, fertilizers and biofertilizers-Integrated Nutrient Management.Soil water plant relationship, crop coefficients, water requirement of crops and critical stages for irrigation, weeds and their control.

Module III

(4 Hours)

Cropping systems- mono cropping, multiple cropping, relay cropping, inter cropping, mixed cropping, crop rotation; organic farming, sustainable agriculture-integrated farming systems, precision farming.

Module IV

(3 Hours)

Scientific cultivation and management of paddy crop-origin, varieties, soil, climate; land preparation and puddling; manuring, fertilizer application, weeding and water management; harvesting and post harvest operations.

Lecture schedule

1. Introduction to agriculture and relevance of the course with respect to agricultural engineers.
2. Agronomy- definition – scope.
3. National and international agricultural research-major institutes.
4. Classification of crops.
5. Weather parameters-temperature, humidity, rainfall, wind, solar radiation.
6. Effect of different weather parameters on crop production.
7. Tillage-definition-principles.
8. Tillage-objective, disadvantages-tilth and its characteristics.

9. Types-benefits-methods of tillage.
10. Crop seasons- sowing-methods.
11. Time and depth of sowing of major field crops.
12. Soil fertility- essential plants nutrients.
13. Plant nutrients-essentiality-functions
14. Deficiency symptoms- plant nutrients
15. Organic manures-types-nutrient content.
16. Inorganic fertilizers- classification- nutrient content -their reactions in soils.
17. Biofertilizers-definition-classification.
18. Methods and time of application of manures, fertilizers and biofertilizers.
19. Integrated nutrient management
20. Mid examination
21. Soil water plant relationship, crop coefficients.
22. Water requirement of crops.
23. Critical stages for irrigation
24. Scheduling of irrigation
25. Weeds-definition-classification
26. Harmful and beneficial effects.
27. Weed control methods-cultural, mechanical.
28. Chemical method of weed control.
29. Biological weed control-integrated weed management.
30. Cropping systems- mono cropping, multiple cropping, relay cropping
31. Inter cropping, mixed cropping, crop rotation
32. Organic farming-Sustainable agriculture-integrated farming systems
33. Precision farming
34. Scientific management of paddy crop-origin, varieties, soil, climate. Land preparation and puddling
35. Manuring, fertilizer application, weeding and water management
36. Harvesting and post harvest operations.

Suggested Reading

- Arnon L. 1972. Crop Production in Dry Regions. Leonard Hill Publishing Co. London.
- Gupta O P. 1984. Scientific Weed Management in the Tropics and Sub- Tropics. Today and Tomorrow's Printers and Publishers. New Delhi.
- Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
- Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers Ludhiana.
- William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York.
- Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.

Sacs. 1206 Engineering mathematics-II 3(2+1)

Objectives

- To understand the concept of complex geometry which is very useful in constructing machines. Complex analyses have a great role in many circuits.
- To understand about Fourier series which represents periodic functions. It is used in the resolution of partial differential equations, which appears in many engineering problems such as heat diffusion, wave propagation and fluid mechanics problem.

Theory

Module I (4 Hours)

Infinite series: Infinite series and its convergence, comparison tests, ratio test, Cauchy's root test, integral test, Raabe's test, Gauss test, absolutely and conditionally convergent series.

Module II (8 Hours)

Fourier Analysis: Periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, functions having point of discontinuity, even and odd functions, Half range series, complex Fourier series, Fourier integrals, Fourier sine and cosine transforms, Fourier transform, properties.

Module III (9 Hours)

Partial differential equations: Formation of partial differential equations, Lagrange's linear equations, homogeneous linear equation with constant coefficients, solution of nonlinear partial differential equations, Charpit's method, method of separation of variables, application of partial differential equations (one dimensional wave and heat flow equations, two dimensional steady state heat flow equation).

Module IV (15 Hours)

Complex analysis: Complex functions, derivative, analytic function, Cauchy-Riemann equations, Laplace's equation, complex integration, line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, power series, functions given by power series, Taylor series and Maclaurin's series. Laurent's series, singularities and zeros, Residue, integration method, Evaluation of real integrals.

Practical

Tutorials on solution of ordinary differential equations of first and higher orders. Series solutions of differential equations. Bessel's and Legendre's differential equations, Convergence of infinite series. Fourier series, harmonic analysis, analytical functions, Cauchy-Riemann equations, harmonic functions, Solution of partial differential equations, Application of partial differential equations.

Lecture schedule

1. Infinite series and its convergence, Comparison tests
2. Ratio test, Cauchy's root test.
3. Integral test, Raabe's test, Gauss test
4. Absolutely and conditionally convergent series
5. Periodic functions, Fourier series, Euler's formulae
6. Dirichlet's conditions, functions having points of discontinuity.
7. Change of interval.
8. Even and odd functions
9. Half range series, Complex Fourier series.

10. Fourier integrals.
11. Fourier sine and cosine transforms
12. Fourier transform , properties.
13. Formation of partial differential equations
14. Lagrange's linear equations
15. Solution of nonlinear partial differential equations
16. Charpit's method
17. Homogeneous linear equation with constant coefficients.
18. Method of separation of variables, application of partial differential equations (one dimensional wave equation)
19. Application of partial differential equations(heat flow equations)
20. Mid examination.
21. Two dimensional steady state heat flow equation
22. Complex functions, limit, derivative, Cauchy-Riemann equations.
23. Analytic function, harmonic function.
24. Laplace's equation
25. Complex integration, Cauchy's theorem.
26. Cauchy's integral formula(problems)
27. Cauchy's integral formula(problems)
28. Power series, Functions given by power series
29. Taylor series and Maclaurin's series
30. Laurent's series
31. Singularities and zeros
32. Residue
33. Residue
34. Evaluation of real definite integrals, integration around the unit circle.
35. Integration around a small semicircle, integration around rectangular contours.
36. Indenting the contours having poles on the real axis.

Practical schedule

1. Infinite series and its convergence, Comparison tests.
2. Ratio test, Cauchy's root test, integral test, Raabes's test.
3. Fourier series, Euler's formulae.
4. Functions having points of discontinuity change of interval.
5. Even and odd functions, Half range series
6. Fourier integrals, Fourier sine and cosine transforms, Fourier transform , properties.
7. Charpit's method
8. Homogeneous linear equation with constant coefficients.
9. Method of separation of variables, application of partial differential equations (one dimensional wave equation)
10. Application of partial differential equations(heat flow equations), Two dimensional steady state heat flow equation
11. Complex integration, Cauchy's theorem, Cauchy's integral formula(problems)
12. Taylor series and Laurent's series
13. Singularities and zeros
14. Residue
15. Evaluation of real definite integrals, integration around the unit circle.
16. Integration around a small semicircle.
17. Integration around rectangular contours.
18. Practical examination.

Suggested Reading

Grewal B S. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.

Narayan Shanti. 2004. A Text Book of Matrices. S. Chand and Co. Ltd. New Delhi.

Ramana B V. 2008. Engineering Mathematics. Tata McGraw-Hill. New Delhi.

Sacs. 1207 Entrepreneurship Development and Business Management 3(2+1)

Objectives

- To familiarize students with various concepts used in understanding processes involved in entrepreneurship and business formation and development.
- To develop and strengthen entrepreneur qualities of students and understand the need for entrepreneur discipline.
- To equip students capable of analysing the environmental set up relating to small industry & small business and make them understand the procedure of small scale industries.
- To develop wide vision about the business and to inculcate in the minds of students the passion for honesty and integrity.

Theory

Module I

(8 Hours)

Entrepreneurship, management – Management functions – planning- Organizing -Directing – motivation – ordering – leading – supervision-Communication and control – Capital – Financial management – importance of financial statements – balance sheet – profit and loss statement, Analysis of financial statements – liquidity ratios – leverage ratios, Coverage ratios – turnover ratios – profitability ratios, Economic principles in management decisions. Agro-based industries – Project – project cycle – Project appraisal and evaluation techniques – undiscounted measures – payback period – proceeds per rupee of outlay, Discounted measures – Net Present Value (NPV) – Benefit-Cost Ratio (BCR) – Internal Rate of Return (IRR) – Net benefit investment ratio (N / K ratio)

Module II

(10 Hours)

Sensitivity analysis-Importance of agribusiness in Indian economy International trade-WTO agreements – Provisions related to agreements in agricultural and food commodities. Agreements on agriculture (AOA) – Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS). Marketing in business management. Development (ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy

Module III

(9 Hours)

Entrepreneurial and managerial characteristics- Entrepreneurship Development Programmes (EDP)- Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment- Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political systems and their implications for decision making by individual entrepreneurs.

Module IV

(9 Hours)

Economic system and its implications for decision making by individual entrepreneurs- Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotion of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract farming (CF) and joint ventures (JV), public-private partnerships (PPP)- Overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

Practical

Preparation of business – Strengths Weaknesses Opportunities and Threats (SWOT) analysis, Analysis of financial statements (Balance Sheet, Profit loss statement). Compounding and discounting, Break-even analysis Visit to agro-based industries – I, Visit to agro-based industries – II Study of Agro-industries Development Corporation , Ratio analysis – I, Ratio analysis – II, Application of project appraisal technique – I(Undiscounted measures), Application of project appraisal technique – II(Discounted Measures), Formulation of project feasibility reports – Farm Machinery Project proposals as entrepreneur – individual and group - Presentation of project proposals in the class.

Lecture schedule

1. Entrepreneurship, management – Management functions – planning- Organizing – Directing – motivation – ordering – leading – supervision
2. Communication and control – Capital – Financial management – importance of financial statements – balance sheet – profit and loss statement.
3. Analysis of financial statements – liquidity ratios – leverage ratios, Coverage ratios – turnover ratios – profitability ratios,
4. Agro-based industries – Project – project cycle .
5. Project appraisal and evaluation techniques
6. undiscounted measures – payback period- proceeds per rupee of outlay, -
7. Discounted measures.
8. Net Present Value (NPV) – Benefit-Cost Ratio (BCR) – Internal Rate of Return (IRR) – Net benefit investment ratio (N / K ratio).
9. sensitivity analysis-Importance of agribusiness in Indian economy International trade- WTO agreements .
10. Provisions related to agreements in agricultural and food commodities.
11. Agreements on agriculture (AOA) – Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures.
12. Trade related intellectual property rights (TRIPS).
13. Development (ED).
- 14: Concept of entrepreneur and entrepreneurship.
15. Assessing overall business environment in Indian economy.
16. Entrepreneurial and managerial characteristics.
17. Entrepreneurship development Programmes (EDP)-
18. Generation incubation and commercialization of ideas and innovations
19. Motivation and entrepreneurship development.
20. Mid Examination.
21. Globalization and the emerging business entrepreneurial environment
22. Managing an Enterprise.
23. Importance of planning,
24. budgeting, monitoring evaluation and follow-up managing competition.

25. Role of ED in economic development of a country
26. Overview of Indian social, political systems and their implications for decision making by individual entrepreneurs.
27. Economic system and its implications for decision making by individual entrepreneurs
28. Social responsibility of business
29. Morals and ethics in enterprise management
30. SWOT analysis- Government schemes and incentives for promotion of entrepreneurship.
31. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors
32. Venture capital (VC)
- 33 Contract farming (CF)
- 34 Joint Ventures (JV),
35. Public-Private Partnerships (PPP)
36. Overview of agricultural engineering industry-Characteristics of Indian farm machinery industry.

Practical schedule

1. Preparation of business Plan
2. Strengths Weaknesses Opportunities and Threats (SWOT) analysis
3. Analysis of financial statements (Balance Sheet, Profit loss statement)
4. Compounding
5. Discounting
6. Break-even analysis Visit to agro-based industries
7. Visit to agro-based industries I
8. Visit to agro-based industries II
9. Visit to Agro -industries Development Corporation.
10. Ratio analysis – I
11. Ratio analysis – II
- 12 Application of project appraisal technique – I(Undiscounted measures)
13. Application of project appraisal technique – II(Discounted Measures)
14. Formulation of project feasibility reports
15. Farm Machinery Project proposals as entrepreneur
16. Individual Presentation of model project proposals in the class
17. Group Presentation of model project proposals in the class.
18. Practical Examination.

Suggested Readings

- Gittenger Price, J. 1989. Economic Analysis of Agricultural Projects. John Hopkins University, Press, London.
- Harsh, S.B., Conner, U.J. and Schwab, G.D. 1981. Management of the Farm Business. Prentice Hall Inc., New Jersey.
- Joseph, L. Massie. 1995. Essentials of Management. Prentice Hall of India Pvt. Ltd., New Delhi.
- Khanka S S. 1999. Entrepreneurial Development. S. Chand and Co. New Delhi.
- Mark J Dollinger. 1999. Entrepreneurship Strategies and Resources. Prentice-Hall, Upper Saddle River, New Jersey.
- Mohanty S K. 2007. Fundamentals of Entrepreneurship. Prentice Hall India Ltd., New Delhi.
- Omri Rawlins, N. 1980. Introduction to Agribusiness. Prentice Hall Inc., New Jersey
- Thomas W Zimmer and Norman M Scarborough. 1996. Entrepreneurship. Prentice-Hall, New Jersey.

Sacs. 1208 Principles of Horticultural Crops and Plant Protection 2(1+1)

Objectives

- To equip the students with the fundamental aspects of horticulture
- To acquaint them with the principles of propagation, production practices, harvesting, post harvest handling and value addition of horticultural crops
- To appreciate the economic importance of pests and diseases and discuss the management and control strategies of plant pests and diseases

Theory

Module I

(6 Hours)

Scope of horticulture. Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties. Criteria for site selection, layout and planting methods, nursery raising, commercial varieties/hybrids, sowing and planting times and methods, seed rate and seed treatment for vegetable crops.

Module II

(7 Hours)

Macro and micro propagation methods, plant growing structures, pruning and training, crop coefficients, water requirements and critical stages, fertilizer application, fertigation, irrigation methods, harvesting, grading and packaging, post harvest practices.

Module III

(5 Hours)

Garden tools, management of orchard, Extraction and storage of vegetables seeds. Major pests and diseases and their management in horticulture crops. Post harvest handling and value addition of major horticultural crops.

Practical

Judging maturity time for harvesting of crop; Study of seed viability and germination test; Identification and description of important fruits, flowers and vegetable crops; Study of different garden tools; Preparation of nursery bed; Practices of pruning and training in some important fruit crops, visit to commercial greenhouse/ polyhouse; cultural operations for vegetable crops (sowing, fertilizer application, mulching, irrigation and weed control); seed extraction techniques; identification of important pests and diseases and their control. Post harvest handling of major horticultural crops.

Lecture schedule

1. Horticulture-definition- scope-major classes of horticultural crops with examples
2. Soil and climatic requirements for fruits, vegetables and floriculture crops
3. Site selection and layout, important varieties/commercial hybrids of horticultural crops
4. Seed rate, seed treatment, raising of nursery and production of quality planting materials of horticultural crops
5. Seed rate, seed treatment, raising of nursery and production of quality planting materials of horticultural crops
6. Main field planting or sowing, planting time and planting methods
7. Macro and micro propagation methods of horticultural crops
8. Macro and micro propagation methods of horticultural crops
9. Crop coefficients, critical stages of crop growth, irrigation methods
10. Mid examination
11. Manuring and fertilizer application in horticultural crops-dose, time and method of application

12. Pruning, training and other management practices in horticultural crops
13. Harvesting and post harvest handling-value addition- grading and packing
14. Garden tools
15. Management of orchard
16. Extraction - storage of vegetable seeds, criteria for quality vegetable seed production
17. Pests and diseases of horticultural crops and their management
18. Pests and diseases of horticultural crops and their management

Practical schedule

1. Judging maturity time for harvesting of crop
2. Study of seed viability and germination test
3. Identification and description of important fruits, flowers and vegetable crops
4. Study of different garden tools
5. Preparation of nursery bed
6. Practices of pruning and training in some important fruit crops
7. Practices of pruning and training in some important fruit crops
8. Practices of pruning and training in some important fruit crops
9. Visit to commercial greenhouse/ polyhouse
10. Cultural operations for vegetable crops - sowing, fertilizer application, mulching
11. Irrigation and weed control for vegetable crops
12. Seed extraction techniques
13. Identification of important pests and diseases
14. Control of important pests and diseases
15. Post harvest handling of major horticultural crops
16. Post harvest handling of major horticultural crops
17. Post harvest handling of major horticultural crops
18. Practical examination

Suggested reading

- S. Prasad and U. Kumar. 2010. Principles of Horticulture. Agrobios, New Delhi.
- S.S. Singh. 1985. Principles and Practices of Agronomy. Kalyani Publishers, Ludhiana.
- T. R. Gopalakrishnan. 2007. Vegetable Crops. New India Publishing Agency, Pitampura, Delhi.
- T. Radha and L. Mathew. 2007. Fruit Crops. New India Publishing Agency, Pitampura, Delhi.
- T. Yellamanda Reddy and G.H. Shankar Reddy. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.

Sacs. 1209 Physical Education and Yoga Practice 0 (0+1)

Objectives

- The physical education program will develop and reinforce cooperative behavior
- The physical education program will teach the students to establish lifelong fitness goals

Practical

Introduction to physical education: Definition, scientific machine principles, objectives, scope, history, development and importance; Physical training and health; Fartlek training and circuit training; Body mechanism and body type: Kretchmark's and Sheldon's classification;

Theories of learning; Exercises for good posture; Exercises to develop physical fitness, growth., flexibility-components, speed, strength, endurance, power, flexibility, agility, coordination and balance; Test and measurement in physical education; Physical fitness test, motor fitness test, ability test, cardiovascular efficiency test and physical fitness index; Calisthenics, weight training, aerobic and anaerobic exercises; interval training, pressure training and resistance training; Importance of Asanas, free hand exercises and yoga; Recreation: Definition, agencies promoting recreation, camping and re-recreation; Governance of sports in India; Organization of tournaments; National and international events; Drawing of fixtures; Rules and regulations; Coaching and fundamentals of skill development of major games, coaching and tactic development of athletic events.

Practical Schedule

1. Health Related Physical Fitness Test - One mile run, Abdominal sit-ups-1 minute, Sit and reach, Modified pull ups, BMI
2. Fartlek training , Circuit training
3. Flexibility components- Speed, Strength, Endurance, Power, Agility, Coordination and balance
4. Yoga and Meditation- Suryanamaskar, Asanas, Pranayama, Meditation
5. Coaching and fundamentals of skill development of major games (Optional: any two)
6. Basketball- Hold, Passing- Chest pass, bounce pass, overhead pass
7. Basketball- Shooting- lay ups- free throw and jump shot
8. Basketball- Moves- two man, three man weave, four man and five man running
9. pass
10. Basketball- Tactics- offences, defense, pivot and screening
11. Volleyball-Stance, passing (upper hand, under hand), Lift- vertical, arch, short, Service- under hand, tennis service, Smash and block
12. Football- Passing and Stopping, instep-inside- back pass- wall pass weaving- Dribbling and long pass, Trapping- Foot trapping- Chest- Thigh and Head
13. Badminton- Grip- Forehand and Backhand, Service, Lob- underhand and overhand, Overhead strokes- Drop shot and Smash, Tactics- Singles and Doubles
14. Coaching and tactic development of athletic events- Conditioning (warming up- jogging- free hand exercises- short sprints), Types of running (sprints- middle and long distances)
15. Coaching and tactic development of athletic events- Start and finish, Types of jumps (long, high jump, pole vault)
16. Coaching and tactic development of athletic events- Types of throws (short put, discus throw, javelin throw, hammer throw), Team events (4X100m relay, 4X400m relay)
17. Coaching and tactic development of athletic events - Combined events (decathlon, heptathlon)
18. Practical Examination

Sacs. 2110 Engineering Mathematics III 3(2+1)

Objectives:

- Testing of hypothesis in statistics is necessary in doing the project analysis and research methodology.
- Numerical methods are very useful in agricultural related subjects.

Theory

Module I (11 Hours)

Numerical analysis and Laplace transformation: finite differences, various difference operators and their relationships. Factorial notation, Interpolation with equal intervals, Newton's forward and backward interpolation formula. Bessel's and Stirling's difference interpolation formula. Interpolation with unequal intervals, Newton's divided difference formula, Lagrange's interpolation formula. Laplace transformation and its application to the solutions of ordinary and simultaneous differential equation.

Module II (9 Hours)

Numerical differentiations, Numerical integrations, Difference equations and their solutions. Numerical solutions of ordinary equations by Picard's method, Taylor series method, Euler's method, Modified Euler's method, RungeKutta method.

Module III (8 Hours)

Measures of central tendency, Measures of dispersion, Correlation, Regression, Normal distribution and standard normal distribution, its properties, Fitting of distributions.

Module IV (8 Hours)

Testing of hypothesis(introduction), level of significance, degrees of freedom, statistical errors, Large sample test(z test), Small sample t test(one tailed, two tailed, paired t test), Testing of significance through variance(F test)- One way ANOVA, Two way ANOVA. Chi square test-goodness of fit, Contingency table.

Practical

Interpolation, Numerical differentiation and integration solutions of difference equations, numerical solution of ordinary differential equations of first order and first degree, Laplace and inverse Laplace transformations and their application to solution of ordinary and simultaneous differential equations. Problems on One Sample, Two sample Z-tests when Population S.D. is known and unknown, Problems on one sample, Two sample and paired t-test Chi-Square test – 2x2 and m x n, Calculation of Correlation coefficient and its testing, Contingency Table and F-test.

Lecture schedule

1. Finite differences.
2. Various difference operators and their relationships.
3. Factorial notation
4. Interpolation with equal intervals, Newton's forward .
5. Backward interpolation formula.
6. Bessel's difference interpolation formula.
7. Stirling's difference interpolation formula
8. Interpolation with unequal intervals, Newton's divided difference formula.

9. Lagrange's interpolation formula
10. Laplace transformation and its application to the solutions of ordinary differential equation.
11. Simultaneous differential equations
12. Numerical differentiations
13. Numerical integrations, Trapezoidal rule.
14. Simpson's rules.
15. Difference equations and their solutions
16. Numerical solutions of ordinary equations by Picard's method.
17. Taylor series method
18. Euler's method.
19. Modified Euler's method. RungeKutta method
20. Mid examination.
21. Measures of central tendency.
22. Measures of dispersion.
23. Correlation.
24. Regression
25. Regression
26. Normal distribution and its properties.
27. Standard normal distribution.
28. Fitting of distributions
29. Testing of hypothesis(introduction), level of significance, degrees of freedom, statistical errors
30. Large sample test(z test).
31. Small sample t test(one tailed, two tailed, paired t test)
32. Testing of significance through variance (F test).
33. One way ANOVA.
34. Two way ANOVA.
35. Chi square test- goodness of fit.
36. Contingency table

Practical schedule

1. Interpolation
2. Numerical differentiations
3. Numerical integrations.
4. Solutions of difference equations.
5. Numerical solutions of ordinary equations of first order and first degree
6. Laplace transforms.
7. Inverse Laplace transformation
8. Application of Laplace and inverse Laplace transformation to solutions of ordinary differential equations.
9. Application of Laplace and inverse Laplace transformation to solutions of simultaneous differential equations
10. Problems on one sample, two sample z test when population S.D is known
11. Problems on one sample, two sample z test when population S.D is unknown
12. Problems on one sample, two sample and paired t test
13. Chi-square test- 2x2 and mxn
14. Calculation of correlation coefficient and its testing
15. Contingency table

16. F test- One way ANOVA.
17. Two way ANOVA
18. Practical examination.

Suggested Readings

Agarwal B L. Basic Statistics. Wiley Eastern Ltd. New Age International Ltd.
B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.
Chandel SRS. A Hand book of Agricultural Statistics. Achal Prakash Masndir, Kanpur.
Gupta S. C. Fundamental Applied Statistics.
Nageswara Rao G. Statistics for Agricultural Sciences. BS Publications.
Rangaswamy R. A Text Book of Agricultural Statistics. New Age International Ltd.

Sacs. 2111 Web Designing and Internet Applications 2(1+1)

Objective

To introduce the novel web technologies to the students and enable them to create website and publish the technology/information gained during their studies/career.

Theory

Module I (7 Hours)

Basic principles in developing a web design, Planning process, Five Golden rules of web designing, Designing navigation bar, Page design, Home Page Layout, Design Concept. Basics in Web Design, Brief History of Internet, World Wide Web, creation of a web site, Web Standards, Audience requirement. Understanding basic HTML tags.

Module II (10 Hours)

Introduction to JavaScript, variables & functions, Working with alert, confirm and prompt, Understanding loop, arrays, Creating rollover image. Working with operator.

Module III (1 Hours)

Connectivity of Web pages with databases; ASP connection string.

Practical

DREAM WEAVER: Exploring Dreamweaver Interface, Planning & Setting Web Site Structure, Working with panels, Understanding and switching views, Using property inspector, Formatting text, JAVA SCRIPT: Working with alert, confirm and prompt, Understanding loop, arrays, Creating rollover image, Working with operator, GIF ANIMATION: Learning to use FTP, Setting FTP, Uploading of site, Using Control panel, FTP UPLOADING SITE: Understanding gif animation interface, Knowing Gif file format, Creating basic web banners, Creating web banners with effects, Creating animated web buttons.

Lecture Schedule

1. Basic principles in developing a web design, Planning process, Five Golden rules of web designing.
2. Design Concept, Designing navigation bar, Page design, Home Page Layout.
3. Basics in Web Design, Brief History of Internet, World Wide Web, Creation of a web site, Web Standards, Audience requirement.
4. HTML tags – formatting, lists, bullets

5. HTML tags –add images, tables
6. HTML tags – forms and events
7. HTML tags- Audio, video, panels
8. Introduction to JavaScript, variables, operators
9. If –else, Switch –case
10. Mid examination.
11. While loop.
12. For loop
13. JavaScript functions .
14. Alert, prompt, Page redirect
15. Objects, creating rollover image.
16. Arrays, Strings
17. For ---in
18. Connectivity of Web pages with databases –ASP connection string to Ms -Access

Practical Schedule

1. DREAM WEAVER: Exploring Dreamweaver Interface
2. Planning & Setting Web Site Structure
3. HTML tags
4. JAVA SCRIPT: Working with variables, operators
5. Understanding loop, while loop
6. For loop
7. alert, confirm and prompt
8. Creating rollover image
9. Gif animation: Understanding gif animation interface, Knowing GIF file format
10. Gif animation: Creating basic web banners, Creating web banners with effects
11. Creating animated web buttons.
12. Learning to use FTP
13. Setting FTP
14. Uploading of site
15. Project
16. Project
17. Project
18. Practical examination.

Suggested Readings

- Dan Donault et al., ASP 3.0 Programmers Reference, Wrox Press.
- Frainand Ben. Responsive Web Design with HTML5
- George Q. Huang, K. L Mak. Internet Applications in Product Design and Manufacturing. ISBN:3540434658.
- Jennifer Niederst Robbins. Developing web design latest edition.
- Nicholas c.Zakas.Java Script for Web Developers.

Sacs. 2112 Communication Skills and Personality Development 2(1+1)

Objectives

- To develop effective communication skills.
- To develop effective presentation skills and acquire grooming techniques.
- To make students self-confident individuals by mastering inter-personal skills, team management skills, and leadership skills
- To develop all-round personalities with a mature outlook to function effectively in different circumstances.
- To bring about personality development with regard to the different behavioural dimensions that has far reaching significance in the direction of organizational effectiveness.

Theory

Module I

(6 Hours)

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication.

Module II

(6 Hours)

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles.

Module III

(6 Hours)

Precis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion, Organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations.

Lecture schedule

1. Communication Skills:
2. Structural and functional grammar;
3. Meaning and process of communication,
4. Verbal and non-verbal communication.
5. Listening and note taking
6. Writing skills
7. Oral presentation skills
8. Field diary
9. Lab record
10. Mid Examination.
11. Indexing-of notes
12. Bibliographic procedures-Reading and comprehension of general
13. Reading and comprehension of technical articles
14. précis writing-Summarizing, abstracting- individual and group presentations

15. Impromptu presentation
16. Public speaking
17. Group discussion.
18. Organizing seminars and conferences

Practical schedule

1. 1.Listening skill
2. Note takingSkill
3. Writing skill
4. Oral presentation skills
5. Field diary
6. Lab record
7. Indexing procedure.
8. Footnote procedure.
9. Bibliographic procedures
10. Reading and comprehension of article.
11. Reading of technical article.
12. Comprehensionof technical article.
13. Précis writing,
14. Summarizing,
15. abstracting
16. Individual presentations
17. Group presentations.
18. Practical Examination.

Suggested Readings

- Balasubramanian T. 1989. A Text book of Phonetics for Indian Students. Orient Longman, New Delhi.
- Balasubrmanyam M. 1985. Business Communication.Vani Educational Books, New Delhi.
- Krishnaswamy,. N and Sriraman, T. 1995. Current English for Colleges.Macmillan India Ltd. Madras.
- Naterop, Jean, B. and Rod Revell. 1997. Telephoning in English. Cambridge University Press, Cambridge.
- Narayanaswamy V R. 1979. Strengthen your writing. Orient Longman, New Delhi.
- Mohan Krishna and Meera Banerjee. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
- Sharma R C and Krishna Mohan. 1978. Business Correspondence. Tata McGrawHill publishing Company, New Delhi.

Sacs. 2213 Applied Electronics and Instrumentation 3(2+1)

Objectives

- To provide an overview of the principles, operation and application of the building blocks like diodes, BJT, OP-amps, Feedback amplifiers, oscillators etc for performing various functions.
- To understand the internal structure of all instruments that are used in measuring parameters related to electronics and to understand how different bridge networks are constructed and balanced for find out values of capacitance , resistance and inductance.

- To understand about different transducers, that are used for measurement purpose and their working principles.

Theory

Module I (8 Hours)

Semiconductors, P-N junction, V-I characteristics of P-N junction, effect of temperature on Barrier voltage, Junction Breakdown, Zener breakdown, avalanche breakdown-Junction capacitance, diode as a circuit element, Half wave rectifier, centre tap Full wave rectifier & bridge rectifiers- efficiency of half wave & full wave rectifiers.

Module II (10 Hours)

Voltage regulators, Zener diode voltage regulator, transistor series regulator, clipper, clamper, voltage multiplier, filter circuits Diode circuits for OR and AND (both positive and negative logic) bipolar junction transistor:, various biasing methods (fixed, self, potential divider), Hartley oscillator, colpitts oscillator, phase shift oscillator , Wein bridge oscillator.

Module III (8 Hours)

OP-AMP, ideal OP-AMP characteristics, linear and non-linear applications of OP-AMP, integrator, active rectifier, comparator, differentiator, OP-AMP voltage regulators; binary adders, Half adders, Full adders, subtractors

Module IV (10 Hours)

Generalized instrumentation systems-Transducers-sensors vs transducer, measurement of displacement, velocity, force measurement using load cells, strain gauge, pressure measurement, low pressure medium and high pressure measurement, Temperature measurement, bimetal strip thermocouple, thermistor-pyrometers.

Practical

To study V-I characteristics of p-n junction diode: To study half wave. full wave and bridge rectifier: To study transistor characteristics in CE configurations: To design and study fixed and self bias transistor: To design and study potential divider bias transistor: To study a diode as clipper and clamper: To study a OP-AMP IC 741 as inverting and non- inverting amplifier: To study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor: To study a OP-AMP IC 741 as differential amplifier: To study a zener regulator circuit: To study a OP-AMP IC 741 as a active rectifier: To study a OP-AMP IC 741 as a comparator: To familiarize with various types of transducers.

Lecture schedule

- 1.Semiconductors-Types of semiconductors-Intrinsic semiconductors-Extrinsic semiconductors Majority and Minority carriers-Mobile charge carriers and immobile ions Current in Intrinsic semiconductors-Intrinsic conduction-Conventional problems
- 2.PN Junction-Formation of depletion Layer-Barrier voltage-effect of temperature on Barrier Voltage
- 3.Forward biased PN Junction- Forward V-I Characteristics- reverse biased PN Junction reverse V-I characteristics- Combined forward and Reverse V-I characteristics
- 4.Junction Breakdown-Zener breakdown-avalanche breakdown-Junction capacitance problems.
- 5.PN Junction diode-Zener diode- Zener voltage regulator

6. Transistor series voltage regulator-photo diode-LED
7. Clippers-positive and negative clipper
8. biased clipper-combination clipper-clampers
9. voltage multiplier-Half wave and full wave voltage doubler-voltage tripler –Voltage Quadrupler
10. filters-LC filter-pi filter
11. Logic Gates-OR - AND gate-
12. diode OR and AND circuits
13. XOR-NOR-NAND-XNOR gates
14. bipolar junction transistor-NPN and PNP transistor
15. transistor biasing-CB configuration-static characteristics
16. CE configuration- relation between α and β - static characteristics
17. CC configuration- relation between transistor currents
18. DC load line-Q point
19. different methods of transistor biasing- base bias-base bias with emitter feed back-base bias with collector feed back-voltage divider bias
20. Mid Exam
21. oscillators-colpits-Hartley
22. phase shift-wein bridge oscillator
23. Op-Amps-virtual ground and summing point- ideal OP-AMP characteristics
24. linear amplifier-unity follower-adder. OP-Amp subtractor, integrator. OP-AMP differentiator-comparator
25. OP-AMP voltage regulators.
26. Generalized Instrumentation system
27. Transducers
28. functional elements of a measurement system
29. measurement of displacement using electrodynamic transducer- LVDT-variable inductance transducer-proximity type electromagnetic transducer
30. measurement of acceleration using eddy current transducer
31. force measurement- hydraulic load cell-pneumatic load cell-strain gauge.
32. pressure measurement-manometers-McLeod Gauge-Pirani Gauge-

33. Ionization Gauge- Knudsen Gauge
34. Temperature measurement- resistance thermometer
35. Thermo electric sensors-pyrometry
36. Total radiation Pyrometer-selective absorption pyrometer.

Practical schedule

1. To study V-I characteristics of p-n junction diode
2. To study half wave rectifier
3. To study full wave and bridge rectifier
4. To study transistor characteristics in CE configurations
5. To design and study fixed and self bias transistor
6. To design and study potential divider bias transistor
7. To study a diode as clipper and clamper
8. To study a OP-AMP IC 741 as inverting
9. To study a OP-AMP IC 741 as non- inverting amplifier
10. To study a OP-AMP IC 741 as differentiator
11. 10. To study a OP-AMP IC 741 as integrator
12. 11. To study a OP-AMP IC 741 as differential amplifier using two transistor
13. 12. To study a OP-AMP IC 741 as differential amplifier
14. 13. To study a Zener regulator circuit
15. 14. To study a OP-AMP IC 741 as a active rectifier
16. 15. To study a OP-AMP IC 741 as a comparator
17. 16. To familiarize with various types of transducers
18. Practical Examination.

Suggested Readings.

- A. Anand Kumar. 2014. Fundamentals of Digital Circuits. PHI Pvt. Ltd., New Delhi.
- A.K. Sawhney. 2010. Course in Electrical and Electronics Measurements and Instrumentation. Dhanpat Rai Publications (P) Limited, New Delhi.
- D. Choudhury Roy. 2003. Linear Integrated Circuits. John Wiley International, NY.
- V.K. Mehta and Rohit Mehta. 2008. Principles of Electronics. S. Chand and Co., New Delhi.
- Sanjeev Gupta. 2002. Electronic Devices and Circuits. Dhanpat Rai Publications (P) , Limited, New Delhi.

Sacs. 3214 Computer Programming and Data Structures 3(1+ 2)

Objective

To provide exposure to develop small programs in C language and thus equip them to solve problems in their chosen field of study using computer program.

Theory

Module I

(7 Hours)

Introduction to high level languages - Introduction to C - History of C – Development environment of C- structure of C program- C tokens & keywords- Primary data types, Variables, constants, character constants, length of data types, header files – use of header files. C operators, building and evaluating arithmetic expressions, type conversions, type casting;

Relational operators, logical operators. Standard library functions. Input statement, output statement, formatted output; importance of documentation. Decision making – branching, if statement, Nested if, switch statement, go to statement. Looping – while, do- while, nested loops, for loop, nested for loop, break, continue statements.

Module II (6 Hours)

Arrays, one dimensional array representation, sorting, searching. Two dimensional arrays – matrix representation, matrix operations. String arrays, representing strings, string operations, string library functions. User defined functions, passing arguments, returning values, recursive functions, storage class, scope and visibility of variables, local & global variables. User defined data types, structures, unions, arrays of structures, structures in user defined functions.

Module III (5 Hours)

Introduction to pointers, passing arguments by address using pointers- pointer representation of arrays, Dynamic Memory allocation functions, self-referential structures, Linked lists, Insertion, deletion operations of linked lists, applications of linked lists, Stacks, push/pop operations, Queues – deletion/insertion of queues.

Practical

Familiarizing with C IDE; Building an executable version of C program; Debugging a C program; Developing and executing simple programs; Creating programs using decision making statements such as if, go to & switch; Developing program using loop statements while, do & for; Using nested control structures; Familiarizing with one and two dimensional arrays; Using string functions; Developing structures and union; Creating user defined functions; Using local, global & external variables; Using pointers; Implementing Stacks; Implementing push/pop functions; Creating queues; Developing linked lists in C language; Insertion/Deletion in data structures.

Lecture Schedule

1. Introduction to C - History of C – Development environment of C- structure of C program- C tokens & keywords- Primary data types, Variables, constants, character constants, length of data types, header files – use of header files
2. C operators, building and evaluating arithmetic expressions, type conversions, type casting; Relational operators, logical operators. Standard library functions. Input statement, output statement, formatted output; importance of documentation.
3. Decision making – branching, if statement Nested if statements
4. switch statement, go to statement.
5. Looping – while, do- while,
6. for loop, nested for loop, break, continue statements.
7. Nested loops –nesting of while, do-while and for loops
8. Arrays, one dimensional array representation, sorting, searching.
9. Two dimensional arrays – matrix representation, matrix operations.
10. Mid examination.
11. String arrays, representing strings, string operations, string library functions.
12. User defined functions, passing arguments, returning values, recursive functions, storage class, scope and visibility of variables, local & global variables
13. User defined data types, structure, union, arrays of structures, structures in user defined functions.
14. Introduction to pointers, passing arguments by address using pointers

15. Pointer representation of arrays.
16. Dynamic Memory allocation functions, self referential structures
17. Linked lists, Insertion, deletion operations of linked lists,
18. Applications of linked lists- Stacks, push/pop operations. Queues – deletion/insertion of queues.

Practical Schedule

1. Simple C programs using operators and output statements
2. Programs using input statement and mathematical equations
3. Programs with library functions and if statements
4. Development of programs with if statement
5. Development of programs with nested if
6. Programs with switch statements
7. Illustrating type casting, go to statement
8. While loop example programs
9. Do-while loop programs
10. Standard programs in C
11. Nested loops with while,
12. Nested loops with do-while statements
13. Programs with for loops
14. Nested for loop illustration programs
15. Break, continue statements
16. One dimensional array creation and calculations and printing
17. Array sorting – selection sort
18. Searching of array
19. Programs with Two dimensional arrays
20. Matrix addition, Transpose, Matrix multiplication
21. String manipulation programs
22. Creating User defined functions with return types
23. Functions of various return types and parameters
24. Programs with structures
25. Programs with unions
26. Programs to illustrate pointers
27. Functions passing parameters by address
28. Functions passing structures as parameters
29. Manipulating arrays with pointers
30. Dynamic memory allocation functions
31. Self referential structures
32. Linked lists – insertion/deletion of linked lists
33. Stacks
34. Push/pop operations
35. Queues – insertion deletion operations
36. Practical examination.

Suggested Readings

- Augenstein, Langsam and Tanenbaum. Data structures using C and C++. PHI/Pearson Education.
- Agarwal, Ajay. The Complete Reference Guide: Data Structure through C. ISBN: 8178840448; Publisher: Cyber Tech Publications.
- Balagurusamy E. 1990. Programming in 'C'.Tata McGraw Hill Publishing Co. Ltd., 12/4 Asaf Ali Road, New Delhi.
- Bronson G and Menconi S. 1995. A First Book of 'C' Fundamentals of 'C' Programming. Jaico Publishing House, New Delhi
- Drozdek Adam. Data Structures and Algorithms in C++.Vikas Publishing House / Thomson International Student Edition.
- Michael T. Goodrich, R. Tamassia and D Mount.Data structures and Algorithms in C++.Wiley Student Edition, John Wiley and Sons.
- Mark Allen Weiss. Data Structures and Algorithm Analysis in C++.Pearson Education.
- Rajaraman V. 1985. Computer Oriented Numerical Methods. Prentice Hall of India. Pvt. Ltd., New Delhi.
- Rajaraman V. 1995.Computer Programming in 'C'. Prentice Hall of India Pvt.Ltd., New Delhi.
- SahniS..Data Structures, Algorithms and Applications in C++. University press (India) Pvt Ltd / Orient Longman Pvt. Ltd.