DETAILED LECTURE OUTLINES

(as per V Deans' Committee Recommendations)
B.Tech. (Agricultural Engineering)
2016

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ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

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ANGRAU

PREFACE

Human resource capital is the greatest treasure. Developing, shaping and conditioning of human resource are the primary goals of any educational institute. The thrust on creating trained quality human resource in agricultural engineering sector abreast with recent technological advances is the need of an hour. Keeping this in view, the present course curriculum is designed as per V Dean's Committee Recommendations. In this course curriculum, transformative changes have been brought in the subject content at undergraduate level by updating, augmenting and revising to achieve necessary quality and need based agricultural engineering education. The course syllabus provides great insight in contextualizing academic aspects of challenges and provides opportunities for enhancing employability, entrepreneurship capabilities enabling graduates to become job providers instead of job seekers through flagship programme *i.e.,* Student READY- Experiential Learning Module in line with Government of India's initiatives *viz.,* Make-in-India, Skill India and Start-up-India.

The Faculty of Agricultural Engineering & Technology express profound gratitude to the former Hon'ble Vice-Chancellors and Dr. A. Vishnuvardhan Reddy, Hon'ble Vice-Chancellor, Acharya N.G. Ranga Agricultural University for their constant support and encouragement rendered.

Date: 20.11.2020
Place: Guntur

(K. Yella Reddy)

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ANGRAU

FOREWORD

Agricultural engineering is a recognised focus of engineering skills and innovation that takes a strongly multidisciplinary approach to agricultural problems. Engineering has a major contribution to make to the required advances in sustainable farming and food, in sympathy with the environment by means of improving efficiency of inputs, conservation of natural resources, reducing post-harvest losses besides adding value to the agricultural produce. The University works with ICAR in a partnership mode in line with recommendations of Fifth Dean's Committee and has contributed significantly in developing first rate human resource in higher agricultural engineering education. The graduates are employed in academic and R&D activities, agricultural production, equipment sales and service, financial management and consultancy and some are self-employed. The profession has made significant contribution in the development of appropriate farm machinery, irrigation and post harvest equipment and energy appliances.

The course syllabus is a tool and acts as a "road map" for the class and puts the students on the same path as the Teacher. By setting the tone and describing the course structure, the syllabus is critical in implementing effective and quality learning meeting demands of farmers and industry. Because of its importance in guiding learning, Faculty distribute a course syllabus books at the beginning of each course offering. This becomes more important where students have not only to learn the recent advances in their subjects but have also to be trained in the modern and latest techniques in their disciplines so that they can participate and contribute in the development and advancement in their related fields. Therefore, proper structuring of the curriculum content and delivery system and recast the same to produce globally competitive man power has gained primacy. The course has been designed by considering demands of private sector harnessing commercial aspects, modern research tools and their applications, supplementary skills required and enhancing the global competitiveness and employability of students.

The Faculty of Agricultural Engineering & Technology involved in developing course curriculum deserve all appreciation for their effort in engineering the agriculture for bringing sustainability and profitability in agricultural production systems.

Date: 20.11.2020
Place: Guntur

(A. Vishnuvardhan Reddy)

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&

All the Teachers of Faculty of Agricultural Engineering & Technology

INDEX

YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF CREDITS AMONG DEPARTMENTS

S. No	Department	First year		Second year		Third year		Final year		Total credit hours		
		I	II	I	II	I	II	I	II	Theory	Practical	Total
1	Farm Machinery and Power Engineering (FMPE)	-	-	-	$\frac{211}{2+1}$	$\frac{311}{2+1}$ $\frac{312}{2+1}$	$\frac{313}{2+1}$ $\frac{314}{0+2}$	-	-	08	06	14
2	Processing and Food Engineering (PFEN)	-	-	-	$\frac{221}{1+1}$	$\frac{321}{2+1}$ $\frac{322}{2+1}$	$\frac{323}{1+1}$ $\frac{324}{2+1}$	-	-	08	05	13
3	Irrigation and Drainage Engineering (IDEN)	-	-	$\frac{231}{2+1}$	$\frac{232}{2+1}$	$\frac{331}{1+1}$	$\frac{332}{1+1}$	-	-	06	04	10
4	Soil and Water Conservation Engineering (SWCE)	-	-	$\frac{241}{1+1}$	$\frac{242}{2+1}$	$\frac{341}{1+1}$	$\frac{342}{2+1}$	-	-	06	04	10
5	Renewable Energy Engineering (REEN)	-	-	-	$\frac{251}{2+1}$	$\frac{351}{1+1}$	$\frac{352}{2+1}$	-	-	05	03	08
6	Basic Engineering (AEBE)	$\frac{161}{1+2}$ $\frac{162}{2+1}$ $\frac{163}{0+2}$	$\frac{164}{2+1}$ $\frac{165}{1+1}$ $\frac{166}{1+2}$ $\frac{167}{2+1}$ $\frac{168}{1+2}$	$\frac{261}{2+0}$ $\frac{262}{1+1}$ $\frac{263}{2+0}$ $\frac{264}{2+1}$	$\frac{265}{0+2}$ $\frac{266}{2+1}$ $\frac{267}{2+1}$	$\frac{361}{1+1}$ $\frac{362}{2+0}$	$\frac{363}{1+1}$	-	-	25	20	45
7	Applied Sciences (AEAS)	$\frac{171}{2+1}$ $\frac{172}{2+1}$ $\frac{173}{2+1}$ $\frac{174}{2+1}$ $\frac{175}{1+1}$	$\frac{176}{2+1}$ $\frac{177}{2+1}$ $\frac{178}{2+1}$	$\frac{271}{1+1}$ $\frac{272}{2+1}$ $\frac{273}{2+1}$	-	-	-	-	-	20	11	31
8	Student READY (SRDY) - Rural and Entrepreneurship Awareness Development Yojana	-	-	-	$\frac{281^{\#}}{0+5}$	-	$\frac{381^{\$}}{0+5}$	$\frac{481}{0+10}$ $\frac{482}{0+10}$ $\frac{483}{0+2}$	$\frac{484}{0+10}$	0	42	42
9	Elective Courses	-	-	-	-	-	-	-	$\frac{\text{ELect}-\text{I}}{2+1}$ $\frac{\text{ELect}-\text{II}}{2+1}$ $\frac{\text{ELect}-\text{III}}{2+1}$	6	3	9
10	Physical Education	$\frac{101^{*}}{0+1}$	$\frac{102^{*}}{0+1}$	-	-	-	-	-	-			
	TOTAL	22 12+10	23 13+10	22 15+7	22+5# 13+9	22 14+08	20+5$ 11+9	22 0+22	19 06+13	**84**	**98**	**182**

* Non-Graded course

5 credits Skill development training - I during summer break.

$ 5 credits Skill development training - II during summer break.

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

Faculty of Agricultural Engineering &Technology

B. Tech. (Agricultural Engineering)

Department-wise Distribution of Credit Load

S. No.	Name of Department	Credit hours
1	Farm Machinery and Power Engineering	**14 (08+06)**
2	Processing and Food Engineering	**13 (08+05)**
3	Irrigation and Drainage Engineering	**10 (06+04)**
4	Soil and Water Conservation Engineering	**10 (06+04)**
5	Renewable Energy Engineering	**08 (05+03)**
6	Basic Engineering	**45 (25+20)**
7	Applied Sciences	**31 (20+11)**
8	Rural and Entrepreneurship Awareness Development Yojana (Student READY)	**42 (00+42)**
	Electives	**09 (06+03)**
9	*Physical Education - Non-Credit Courses*	*02 (00+02)*
	Total	**182 (84+98)**

Department-wise Distribution of Courses

S. No.	Course No.	Title of the Course	Credit hours
		Farm Machinery and Power Engineering (1)	
1	FMPE 211	Tractor and Automotive Engines	3 (2+1)
2	FMPE 311	Farm Machinery and Equipment-I (Tillage and Sowing operations)	3 (2+1)
3	FMPE 312	Tractor Systems and Controls	3 (2+1)
4	FMPE 313	Farm Machinery and Equipment-II (Intercultural, Harvesting and Threshing operations)	3 (2+1)
5	FMPE 314	Tractor and Farm Machinery Operation and Maintenance	2 (0+2)
		Total	**14 (8+6)**
		Processing and Food Engineering (2)	
1	PFEN 221	Engineering Properties of Biological Materials	2 (1+1)
2	PFEN 321	Agricultural Structures and Environmental Control	3 (2+1)
3	PFEN 322	Post Harvest Engineering of Cereals, Pulses and Oilseeds	3 (2+1)
4	PFEN 323	Post Harvest Engineering of Horticultural Crops	2 (1+1)
5	PFEN 324	Dairy and Food Engineering	3 (2+1)
		Total	**13 (8+5)**

Irrigation and Drainage Engineering (3)

S. No.	Course No.	Title of the Course	Credit hours
1	IDEN 231	Ground Water, Wells and Pumps	3 (2+1)
2	IDEN 232	Irrigation Engineering	3 (2+1)
3	IDEN 331	Sprinkler and Micro Irrigation Systems	2 (1+1)
4	IDEN 332	Drainage Engineering	2 (1+1)
		Total	**10 (6+4)**

Soil and Water Conservation Engineering (4)

1	SWCE 241	Watershed Hydrology	2 (1+1)
2	SWCE 242	Soil and Water Conservation Engineering	3 (2+1)
3	SWCE 341	Watershed Planning and Management	2 (1+1)
4	SWCE 342	Water Harvesting and Soil Conservation Structures	3 (2+1)
		Total	**10 (6+4)**

Renewable Energy Engineering (5)

1	REEN 251	Fundamentals of Renewable Energy Sources	3 (2+1)
2	REEN 351	Renewable Power Systems	2 (1+1)
3	REEN 352	Bio-energy Systems: Design and Applications	3 (2+1)
		Total	**8 (5+3)**

Basic Engineering (6)

1	AEBE 161	Surveying and Levelling	3 (1+2)
2	AEBE 162	Engineering Mechanics	3 (2+1)
3	AEBE 163	Engineering Drawing	2 (0+2)
4	AEBE 164	Fluid Mechanics and Open Channel Hydraulics	3 (2+1)
5	AEBE 165	Strength of Materials	2 (1+1)
6	AEBE 166	Workshop Technology and Practices	3 (1+2)
7	AEBE 167	Applied Electronics and Instrumentation	3 (2+1)
8	AEBE 168	Computer Programming and Data Structures	3 (1+2)
9	AEBE 261	Heat and Mass Transfer	2 (2+0)
10	AEBE 262	Soil Mechanics	2 (1+1)
11	AEBE 263	Theory of Machines	2 (2+0)
12	AEBE 264	Electrical Machines and Power Utilization	3 (2+1)
13	AEBE 265	Auto CAD Applications	2 (0+2)
14	AEBE 266	Machine Design	3 (2+1)
15	AEBE 267	Thermodynamics, Refrigeration and Air Conditioning	3 (2+1)
16	AEBE 361	Design of Structures	2 (1+1)
17	AEBE 362	Building Construction and Cost Estimation	2 (2+0)
18	AEBE 363	Web Designing and Internet Applications	2 (1+1)
		Total	**45 (25+20)**

Applied Sciences (7)

S. No.	Course No.	Title of the Course	Credit hours
1	AEAS 171	Engineering Mathematics-I (Matrices and Calculus)	3 (2+1)
2	AEAS 172	Engineering Physics	3 (2+1)
3	AEAS 173	Engineering Chemistry	3 (2+1)
4	AEAS 174	Principles of Agronomy and Organic Farming	3 (2+1)
5	AEAS 175	Communication Skills and Personality Development	2 (1+1)
6	AEAS 176	Engineering Mathematics-II (Differential Equations)	3 (2+1)
7	AEAS 177	Environmental Science and Disaster Management	3 (2+1)
8	AEAS 178	Principles of Soil Science	3 (2+1)
9	AEAS 271	Principles of Horticultural Crops and Plant Protection	2 (1+1)
10	AEAS 272	Entrepreneurship Development and Business Management	3 (2+1)
11	AEAS 273	Engineering Mathematics-III (Numerical analysis and Statistical methods)	3 (2+1)
		Total	**31 (20+11)**

Student READY (8)
Rural and Entrepreneurship Awareness Development Yojana

1	SRDY 281	Skill Development Training-I (4 Weeks-During Summer break after IV Semester)	5 (0+5)
2	SRDY 381	Skill Development Training-II (4 Weeks -During Summer break after VI Semester)	5 (0+5)
3	SRDY 481	Industrial Attachment/Internship (10 weeks)	10 (0+10)
4	SRDY 482	Experiential Learning On-Campus (10 weeks)	10 (0+10)
5	SRDY 483	Educational Tour (2 weeks- During first week of January)	2 (0+2)
6	SRDY 484	Project Work and Report Writing (20 weeks)	10 (0+10)
		Total	**42 (0+42)**

Elective Courses

S. No.	Particulars	Credit hours
1	Elective 1	3 (2+1)
2	Elective 2	3 (2+1)
3	Elective 3	3 (2+1)
	Total	**9 (6+3)**

Physical Education
(Non-Credit Courses)

1	COCA 101	NSS/NCC	1 (0+1)
2	COCA 102	Physical Education & Yoga Practice	1 (0+1)
		Total	**2 (0+2)**

Elective Courses

A Student can choose any of the 3 courses (9 credit hours) from approved list of Elective Courses depending on the interest and the facilities available for offering these courses by the college.

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY
Faculty of Agricultural Engineering & Technology
B. Tech. (Agricultural Engineering) Degree
YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF COURSES

I YEAR I SEMESTER

S. No.	Course No.	Title of the Course	Credit hours (T+P)
1	AEBE 161	Surveying and Levelling	3 (1+2)
2	AEBE 162	Engineering Mechanics	3 (2+1)
3	AEBE 163	Engineering Drawing	2 (0+2)
4	AEAS 171	Engineering Mathematics-I (Matrices and Calculus)	3 (2+1)
5	AEAS 172	Engineering Physics	3 (2+1)
6	AEAS 173	Engineering Chemistry	3 (2+1)
7	AEAS 174	Principles of Agronomy and Organic Farming	3 (2+1)
8	AEAS 175	Communication Skills and Personality Development	2 (1+1)
9	COCA 101	NSS/NCC (Non-credit course)	1 (0+1) *
		Total	**22 (12+10)**

I YEAR II SEMESTER

1	AEBE 164	Fluid Mechanics and Open Channel Hydraulics	3 (2+1)
2	AEBE 165	Strength of Materials	2 (1+1)
3	AEBE 166	Workshop Technology and Practices	3 (1+2)
4	AEBE 167	Applied Electronics and Instrumentation	3 (2+1)
5	AEBE 168	Computer Programming and Data Structures	3 (1+2)
6	AEAS 176	Engineering Mathematics-II (Differential Equations)	3 (2+1)
7	AEAS 177	Environmental Science and Disaster Management	3 (2+1)
8	AEAS 178	Principles of Soil Science	3 (2+1)
9	COCA 102	Physical Education & Yoga practice (Non-credit course)	1 (0+1) *
		Total	**23 (13+10)**

II YEAR I SEMESTER

1	IDEN 231	Groundwater, Wells and Pumps	3 (2+1)
2	SWCE 241	Watershed Hydrology	2 (1+1)
3	AEBE 261	Heat and Mass Transfer	2 (2+0)
4	AEBE 262	Soil Mechanics	2 (1+1)
5	AEBE 263	Theory of Machines	2 (2+0)
6	AEBE 264	Electrical Machines and Power Utilization	3 (2+1)
7	AEAS 271	Principles of Horticultural Crops and Plant Protection	2 (1+1)
8	AEAS 272	Entrepreneurship Development and Business Management	3 (2+1)
9	AEAS 273	Engineering Mathematics-III (Numerical analysis and Statistical methods)	3 (2+1)
		Total	**22 (15+7)**

T= Theory (1 h) P= Practical (2-3 h)

II YEAR II SEMESTER

S. No.	Course No.	Title of the Course	Credit hours (T+P)
1	FMPE 211	Tractor and Automotive Engines	3 (2+1)
2	PFEN 221	Engineering Properties of Biological materials	2 (1+1)
3	IDEN 232	Irrigation Engineering	3 (2+1)
4	SWCE 242	Soil and Water Conservation Engineering	3 (2+1)
5	REEN 251	Fundamentals of Renewable Energy Sources	3 (2+1)
6	AEBE 265	Auto CAD Applications	2 (0+2)
7	AEBE 266	Machine Design	3 (2+1)
8	AEBE 267	Thermodynamics, Refrigeration and Air Conditioning	3 (2+1)
		Total	**22 (13+09)**
9	SRDY 281	Skill Development Training-I (Student READY) (4 Weeks- During Summer break after IV Semester)	5 (0+5)

III YEAR I SEMESTER

1	FMPE 311	Farm Machinery and Equipment-I (Tillage and Sowing operations)	3 (2+1)
2	FMPE 312	Tractor Systems and Controls	3 (2+1)
3	PFEN 321	Agricultural Structures and Environmental Control	3 (2+1)
4	PFEN 322	Post Harvest Engineering of Cereals, Pulses and Oilseeds	3 (2+1)
5	IDEN 331	Sprinkler and Micro Irrigation Systems	2 (1+1)
6	SWCE 341	Watershed Planning and Management	2 (1+1)
7	REEN 351	Renewable Power Systems	2 (1+1)
8	AEBE 361	Design of Structures	2 (1+1)
9	AEBE 362	Building Construction and Cost Estimation	2 (2+0)
		Total	**22 (14+8)**

III YEAR II SEMESTER

1	FMPE 313	Farm Machinery and Equipment-II (Intercultural, Harvesting and Threshing operations)	3 (2+1)
2	FMPE 314	Tractor and Farm Machinery Operation and Maintenance	2 (0+2)
3	PFEN 323	Post Harvest Engineering of Horticultural Crops	2 (1+1)
4	PFEN 324	Dairy and Food Engineering	3 (2+1)
5	IDEN 332	Drainage Engineering	2 (1+1)
6	SWCE 342	Water Harvesting and Soil Conservation Structures	3 (2+1)
7	REEN 352	Bio-energy Systems: Design and Applications	3 (2+1)
8	AEBE 363	Web Designing and Internet Applications	2 (1+1)
		Total	**20 (11+9)**
9	SRDY 381	Skill Development Training-II (Student READY) (4 Weeks- During Summer break after VI Semester)	5 (0+5)

IV YEAR I SEMESTER

S. No.	Course No.	Title of the Course	Credit hours (T+P)
1	SRDY 481	Industrial Attachment/Internship (Student READY) (10 weeks)	10 (0+10)
2	SRDY 482	Experiential Learning On-Campus (Student READY) (10 weeks)	10 (0+10)
3	SRDY 483	Educational Tour (Student READY) (2 weeks- During first week of January)	2 (0+02)
		Total	**22 (0+22)**
		IV YEAR II SEMESTER	
1	SRDY 484	Project Work and Report Writing (Student READY) (20 weeks)	10 (0+10)
2		Elective courses (Any 3 courses of the following)	9 (6+03)
		Total	**19 (6+13)**
		Grand Total	**182 (84+98)**
		Elective Courses (Any 3 courses)	
1	FMPE 411	Mechanics of Tillage and Traction	3 (2+1)
2	FMPE 412	Farm Machinery Design and Production	3 (2+1)
3	FMPE 413	Human Engineering and Safety	3 (2+1)
4	FMPE 414	Tractor Design and Testing	3 (2+1)
5	FMPE 415	Hydraulic Drives and Controls	3 (2+1)
6	FMPE 416	Precision Agriculture and System Management	3 (2+1)
7	FMPE 417	Mechatronics	3 (2+1)
8	PFEN 421	Food Quality and Control	3 (2+1)
9	PFEN 422	Food Plant Design and Management	3 (2+1)
10	PFEN 423	Food Packaging Technology	3 (2+1)
11	PFEN 424	Development of Processed Products	3 (2+1)
12	PFEN 425	Process Equipment Design	3 (2+1)
13	PFEN 426	Waste and By-products Utilization	3 (2+1)
14	PFEN 427	Artificial Intelligence	3 (3+0)
15	IDEN 431	Management of Canal Irrigation System	3 (2+1)
16	IDEN 432	Minor Irrigation and Command Area Development	3 (2+1)

S. No.	Course No.	Title of the Course	Credit hours (T+P)
17	IDEN 433	Water Quality and Management Measures	3 (2+1)
18	IDEN 434	Landscape Irrigation Design and Management	3 (2+1)
19	IDEN 435	Plastic Applications in Agriculture	3 (2+1)
20	SWCE 441	Floods and Control Measures	3 (2+1)
21	SWCE 442	Wasteland Development	3 (2+1)
22	SWCE 443	Information Technology for Land and Water Management	3 (2+1)
23	SWCE 444	Remote Sensing and GIS Applications	3 (2+1)
24	SWCE 445	Precision Farming Techniques for Protected Cultivation	3 (2+1)
25	REEN 451	Photovoltaic Technology and Systems	3 (2+1)
		Total	**75 (51+24)**

*** Non gradial courses**

Department of Farm Machinery and Power Engineering

FMPE 211 Tractor and Automotive Engines 3 (2+1)

Course outlines

Theory

Study of sources of farm power – conventional & non-conventional energy sources. Classification of tractors and IC engines. Review of thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle. General energy equation and heat balance sheet. Study of mechanical, thermal and volumetric efficiencies. 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 engine valve systems, valve mechanism, valve timing diagram and valve clearance adjustment. Study of cam profile, valve lift and valve opening area. Study of importance of air cleaning system. Study of types of air cleaners and performance characteristics of various air cleaners. Study of fuel supply system. Study of fuels, properties of fuels, calculation of air-fuel ratio. Study of tests on fuel for SI and CI engines. Study of detonation and knocking in IC engines. Study of carburetion system, carburetors and their main functional components. Study of fuel injection system – injection pump, their types, working principles. Fuel injector nozzles – their types and working principle. Engine governing – need of governors, governor types and governor characteristics. 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. Study of need and type of thermostat valves. Additives in the coolant. Study of radiator efficiency. Study of ignition system of SI engines. Study of electrical system including battery, starting motor, battery charging, cut-out, etc. Comparison of dynamo and alternator. Familiarization with the basics of engine testing.

Practical

Introduction to different systems of CI engines. Engine parts and functions, working principles, etc. Valve system – study, construction and adjustments. Oil & Fuel – determination of physical properties. Air cleaning system. Fuel supply system of SI engine. Diesel injection system & timing. Cooling system, and fan performance, thermostat and radiator performance evaluation. Part load efficiencies & governing. 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.

Objectives

To make the students to able to understand the working of automobiles in general and tractors in particular.

Lecture

Theory

1	Sources of farm power available in India
2	Conventional & non-conventional energy sources
3	Classification of tractors and IC engines
4	Classification of tractors and IC engines
5	Thermodynamic principles of CI engines and deviation from ideal cycle, general energy equation and heat balance sheet.
6	Thermodynamic principles of SI engines and deviation from ideal cycle, general energy equation and heat balance sheet.
7	Mechanical, thermal and volumetric efficiencies.
8	Engine components and their construction, operating principles and functions
9	Engine operating principles and functions
10	Engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines.
11	Engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines.
12	Engine valve systems and valve mechanism
13	Engine valve mechanism, valve timing diagram and valve clearance adjustment
14	Cam profile, valve lift and valve opening area
15	Importance of air cleaning system
16	Types of air cleaners and performance characteristics of various air cleaners
17	Fuel supply system and different types of fuels
18	Properties of fuels, calculation of air-fuel ratio
19	Tests on fuel for SI and CI engines, detonation and knocking in IC engines
20	Carburetion system, carburetors and their main functional components
21	Fuel injection system – Injection pump, their types, working principles
22	Fuel injector nozzles – their types and working principle
23	Engine governing – need of governors, governor types and governor characteristics
24	Lubrication system – need, types, functional components
25	Lubricants – physical properties, additives and their application
26	Engine cooling system – need, cooling methods and main functional components
27	Need and type of thermostat valves. Additives in the coolant. Study of radiator efficiency
28	Ignition system of SI engines. Study of electrical system including battery, starting motor, battery charging, cut-out, etc. Comparison of dynamo and alternator
29	Electrical system including battery, starting motor, battery charging and cut-out
30	Comparison of dynamo and alternator
31	Familiarization with the basics of engine testing
32	Familiarization with the basics of engine testing

Practical

1 Introduction to different systems of CI engines - engine parts and functions and working principles

2 Introduction to different systems of SI engines - Engine parts and functions and working principles

3 Valve system – study, construction and adjustments

4 Oil & Fuel – determination of physical properties

5 Air cleaning system

6 Fuel supply system of SI engine and timing

7 Fuel supply system of Diesel injection system and timing

8 Cooling system and fan performance, thermostat and radiator performance evaluation

9 Cooling system and fan performance, thermostat and radiator performance evaluation

10 Part load efficiencies and governing

11 Part load efficiencies and governing

12 Lubricating system and adjustments

13 Starting and electrical system, ignition system

14 Tractor engine heat balance and engine performance curves

15 Visit to engine manufacturer/ assembler/ spare parts agency

16 Practical Examination

References

1. Liledahi J B, Carleton W M, Turnquist P K and Smith D.W., 1984. Tractors and Their Power Units. AVI Publishing Co. Inc.
2. Rodichev V and G Rodicheva., 1984. Tractors and Automobiles, Mir Pub., Moscow.
3. M. L. Mathur And R.P. Sharma, A course in internal combustion engines, Dhanpat Rai & sons India.
4. Kirpal Singh, 2011, Automobile Engineering Vol 2, Standard Publishers, New Delhi.
5. Heiner Joseph, 1999, Automotive Mechanics, Litton Educational Publishing Ins., Network, USA.
6. Jagdishwar Sahay. 2015. Elements of Agricultural Engineering. Standard Publishers, New Delhi.
7. S.C Jain & C.R. Rai, 2001 Farm Tractor Maintenance & Repair, Standard Publishers Distributors, New Delhi
8. Nakra C.P., 2009. Farm Machines and Equipments. Dhanpat Rai Publishers, New Delhi

FMPE 311 **Farm Machinery and Equipment – I**
(Tillage and Sowing Operations) **3 (2+1)**

Course outlines

Theory

Introduction to farm mechanization. Classification of farm machines. Unit operations in crop production. Identification and selection of machines for various operations on the farm. Hitching systems and controls of farm machinery. Calculation of field capacities and field efficiency. Calculations for economics of machinery usage, comparison of ownership with hiring of machines. Introduction to seed-bed preparation and its classification. Familiarization with land reclamation and earth moving equipment. Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows, cultivators, Identification of major functional components. Attachments with tillage machinery. 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. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/ planters. Adjustments during operation. 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.

Objectives

To impart knowledge on primary and secondary tillage implements along with earth moving machinery, seeding equipment, etc.

Lecture

Theory

1 Objectives of farm mechanization, scope of farm mechanization and classification of farm operations and its sequence - farm machines

2 Introduction to materials used in construction of farm machines. Properties of materials used for critical and functional components of agricultural machines

3 Heat treatment processes and their requirement in farm machines. Introduction to steels and alloys for agricultural application

4 Earth moving equipment – Introduction, types, soil properties affecting measurement in earth work projects, production estimation

5 Earth moving equipment construction and working principles – Shovels

6 Earth moving equipment construction and working principles – bulldozers, trenching machines and elevators

7 Introduction to tillage – objectives, advantages, classification.

8 Primary tillage implements – indigenous plough, mould board plough – components and its accessories, adjustments

9 Primary tillage implements – disc plough (types and trouble shooting), chisel plough, sub-soiler

10 Ploughing of land and methods of ploughing

11 Hitching systems – types, methods of hitching and controls

12 Forces acting upon a tillage tools and their analysis.

13 Measurement of draft of tillage tools and calculations for power requirement for the tillage machines, effect of speed upon draft

14 Secondary tillage implements – harrows, rotary plough, rotavator, rotating auger plough

15 Secondary tillage implements – cultivators, puddler, bund former, ridger, soil scoop, green manure trampler

16 Calculation of field capacities and field efficiencies of primary and secondary tillage equipment

17 Introduction to sowing, seedling and planting methods

18 Introduction to seed drill – types and components of seed drill

19 Different types of seed metering devices of seed drill, common types of fertilizer metering devices

20 Different types of furrow openers of seed drill

21 Calibration of seed drill and seed cum fertilizer drill, test for seed uniformity

22 Introduction to planters and seed metering devices in a planter and different types of furrow openers of planter

23 Sugarcane planter – types, construction details and principles of operation

24 Potato planter - types, construction details and principles of operation

25 Rice trans planter - types, construction details and principles of operation

26 Introduction to no-till drill and strip till drill machines, bed planters

27 Introduction to Pneumatic planter and its working principle, construction

28 Calculation of field capacities and field efficiencies of sowing equipment

29 Introduction to testing of farm machines – importance and types of testing procedures and systems, regulations governing in all tests

30 Different test codes available for testing of tillage and sowing machines, study of test codes and procedures for mould board plough, seed cum fertilizer drill and rice trans planter

31 Selection and management of farm machines for optimum performance

32 Calculations for economics of machinery usage, comparison of ownership with hiring of farm machines

Practical

1 Familiarization with different farm implements and tools - Visit to implements shed and research hall

2 Identification of materials of construction for various components of agricultural machinery.

3 Visit to local foundry to study various heat treatment processes for agricultural machinery tools

4 Study of earth moving equipment

5 Determination of field capacity and field efficiency of primary tillage implements

6 Determination of field capacity and field efficiency of secondary tillage implements

7 Study of hitching systems of implements & practicing

8 Solving problems on machinery management – cost of operation, payback period etc

9 Draft, horse power and fuel consumption measurement for different implements

10 Study of different types of plough bottoms and shares, determination of disc angle, tilt angle, concavity of a disc plough

11 Study of seed cum ferti drill and seed metering mechanisms

12 Calibration of seed drill and repairs/trouble shooting of seed drills

13 Study of working of rotavator and calculation of soil tilth

14 Study of no-till drill, strip till drill, bed planters, Pneumatic planter and sugar cane planer

15 Study of trans planters - Paddy and vegetables

16 Practical Examination

References

1. Kepner R.A., Roy Bainer and Barger E.L. 2005. Principles of Farm Machinery. C.B.S Publishers & Distributors Pvt Ltd., New Delhi.
2. Harris Pearson Smith, 2011. Farm Machinery and Equipment, Morse Press, Lanaken Belgium.
3. Claude Culpin, 2013. Farm Machinery, Read Books Ltd., U. K.
4. AC.srivastava and Raju Primlari, 1991. Element of Farm Machinery, Oxford &IBH Publishing Co. Pvt Ltd, New Delhi.
5. Radhey Lal and Datta A.C. 2011. Agricultural Engineering (Through Worked Examples). Saroj Prakashan. 646 Katra, Allahabad.
6. Jagdishwar Sahay. 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi.
7. Surendra Singh. 2011. Farm Machinery Principles and Applications. ICAR, New Delhi.
8. Srivastava A.K, Goering C.E, Rohrbach R.P and Buckmaster D.R. 2006. Engineering Principles of Agricultural Machines. ASABE, USA.
9. Borshchov, T., Mansurov, R. & Sergeev, V, 1988. Land Reclamation Machinery, Mir Publishers, Moscow
10. Mehta M.L, Verma S.R, Misra S.K and Sharma V.K. 2005. Testing and Evaluation of Agricultural Machinery. Daya Publishing House, Delhi.

FMPE 312 Tractor Systems and Controls 3 (2+1)

Course outlines

Theory

Study of need for transmission system in a tractor. Transmission system – types, major functional systems. 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 – gearing theory, principle of operation, gear box types, functional requirements, and calculation for speed ratio. Study of differential system – need, functional components, construction, calculation for speed reduction. Study of need for a final drive. Study of brake system – types, principle of operation, construction, calculation for braking torque. Study of steering system – requirements, steering geometry characteristics, functional components, calculation for turning radius. Familiarization with Ackerman steering. Steering systems in track type tractors. Study of hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements. Familiarization with the hydraulic system adjustments and ADDC. Study of tractor power outlets – PTO. PTO standards, types and functional requirements. 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. 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. Ergonomic considerations and operational safety. Introduction to tractor testing. Deciphering the engine 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.

Objectives

To enable the students for acquiring the knowledge pertaining to systems like transmission system clutch types of clutches, types of gears, tractor power outlets like P.T.O., tractor stability, testing of tractor and ergonomics

Lecture

Theory

1 Introduction to transmission system - drive train of tractor , necessity of drive train, components of dive train, functions of dive train

2 Clutch – need, types, functional requirements, construction and principle of operation. Familiarization with mechanical and hydraulic clutches – single, multi, centrifugal and dual clutch systems

3 Clutch- Construction and working of fluid coupling and torque converter

4 Gear box – gearing theory, principle of operation

5 Gear box types, functional requirements and calculation of speed ratio.

6 Gear box – construction and working of sliding mesh and constant mesh gear box

7 Differential – need, functional components, construction and calculation for speed reduction

8 Final drive system – need, functional components, construction and working

9 Brake system – types, principle of operation, construction, calculation of braking torque

10 Brake system – working of mechanical brake, internal expanding, external contracting

11 Brake system - working of disc brake and hydraulic brake, qualities of good brakes

12 Steering system – types, requirements, steering geometry characteristics, functional components- working of mechanical steering- working of power steering

13 Steering system – Conditions of good steering, advantages of power steering , qualities of good steering, familiarization with Ackerman steering, steering systems in track type tractors

14 Steering system – types of steering gear boxes and its construction and working principle.

15 Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements, types of hydraulic controls

16 Hydraulic system in a tractor — necessity of hydraulic controls, importance and working of draft control and position control system, hitching of implements , familiarization with the hydraulic system adjustments and ADDC (Auto Draft and Depth Control)

17 Hitching system in a tractor – construction and working of three point linkage mechanism, force analysis, terminology related to hitching, types of three point hitch operation, free link and restrained link operation

18 Tractor power outlets – PTO, drawbar, hydraulic system, PTO construction, PTO standards, types and functional requirements

19 Introduction to traction- traction terminology and characteristics

20 Traction theory- traction aids

21 Theoretical calculations of thrust force and rolling resistance on traction device using various empirical methods

22 Wheels and tyres – types like solid tyres and pneumatic tyres and their construction

23 Wheels and tyres – tyre specifications, tyre terminology, ply rating

24 Study of tractor mechanics – forces acting on the tractor, free body diagram of tractor implement combination, methods of CG measurement of tractor.

25 Tractor stability- Longitudinal stability, Lateral stability, mechanics of tractor under static condition, mechanics of tractor under dynamic, mechanics of tractor implement combination, weight transfer and its importance, determination of maximum drawbar pull

26 Study of tractor stability - types of tractor accidents , precautions to overcome tractor accidents, condition to avoid sideways overturning of tractor during turning, safety devices in tractor

27 Introduction to tractor testing and performance - preparation of tests

28 Types of tractor tests – test procedures, power test, Ergonomical tests and miscellaneous tests

29 Introduction to tractor testing- representation of test results, deciphering the engine test codes, test codes for various tests.

30 Tractor chassis- functions , types of chassis, Precautions to be taken for prolonged life

31 Ergonomic considerations and operational safety of tractor, safety measures in tractor, ROPS, construction.

32 Familiarization with tractor as a spring-mass system - determination and importance of moment of inertia of a tractor, static equilibrium of tractor

Practical

1 Introduction to transmission systems and components and study of clutch functioning, parts and design problem on clutch system

2 Study of different types of gear box, calculation of speed ratios

3 Design problems on gear box

4 Study on differential and final drive and planetary gears

5 Study of brake systems and design problems

6 Steering geometry and adjustments

7 Study of hydraulic systems in a tractor

8 Study of three point linkage mechanism in a tractor, adjustments in field

9 Determination of location of CG of a tractor, Moment of Inertia of a tractor

10 Traction performance of a tractor wheel

11 Operational safety and ROPS construction

12 Study of tractor chassis

13 Driving practice of tractor

14 Driving practice of tractor

15 Driving practice of tractor

16 Practical Examination

References

1. Jagdishwar Sahay. 2015. Elements of Agricultural Engineering. Standard Publishers, New Delhi.

2. Nakra C.P., 2009. Farm Machines and Equipments. Dhanpat Rai Publishers, New Delhi

3. Sanjay Kumar. 2007. A Textbook of tractor at Glance. International Book Distributing Company, New Delhi.

4. Liledahi J B, Carleton W M, Turnquist P K and Smith D.W., 1984. Tractors and Their Power Units. AVI Publishing Co. Inc., Westport, Connecticut.

FMPE 313 Farm Machinery and Equipment – II
(Intercultural, Harvesting and Threshing Operations) 3 (2+1)

Course outlines

Theory

Introduction to plant protection equipment – sprayers and dusters. Classification of sprayers and sprays. Types of nozzles. 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. 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. 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. Study of root crop diggers – principle of operation, blade adjustment and approach angle, and calculation of material handled. Study of potato and groundnut diggers. Study of Cotton harvesting – Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Sugar cane harvester. Introduction to vegetables and fruit harvesting equipment and tools.

Practical

Familiarization with plant protection and intercultural 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.

Objectives

To enable the students to understand the basic principles of plant protection equipment, cutting mechanisms on various harvesting machines, working principles of threshers, harvesting of field and horticultural crops, etc. and finally with test codes of agricultural machines.

Lecture

Theory

1 Introduction to intercultural equipment – dryland and wet land weeders, use of weeders – manual and power operated types – working principles and functional components.

2 Introduction to fertilizer application equipment, manually operated fertilizer broadcaster, tractor operated fertilizer broadcaster, anhydrous ammonia applicator, slurry distributor, manure spreader, super granule applicator

3 Introduction to plant protection equipment – history, types, functions and uses

4 Sprayer drift, factors affecting drift, types of spray, different ways of expressing sprayer droplet size, droplet size measurement, types of spray

5 Types of Sprayer – hand sprayer, stirrup pump sprayer, lever operated knapsack sprayer, compression knapsack sprayer, motorized knapsack sprayer, foot operated sprayer, rocker sprayer

6 Battery operated sprayer – ULV sprayer, power operated sprayer – air blast sprayer and boom sprayer, duster – shoulder mounted rotary duster and belly mounted rotary duster.

7 Selection of spraying equipment and calibration of sprayer, pumps for spraying, different types of nozzles for different types of spray patterns, spray agitating systems.

8 Calculation of field capacities, spray pattern angles, spray height and discharge rate of sprayers

9 Harvesting – introduction, principles, methods. Sickle – construction details and working, impact cutter – rotary cutter and flail shredder.

10 Mowers – working principle, types, components, construction details, adjustments.

11 Shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology, cutting pattern.

12 Reapers, binders and windrowers – principles of operation and constructional details.

13 Calculation of field capacities and field efficiencies of mowers and reapers.

14 Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay.

15 Introduction to threshing – principle of threshing, threshing methods, types of power thresher, components of power thresher

16 Types of threshing drums and their applications. Types of threshers- tangential and axial, their constructional details and cleaning systems.

17 Factors affecting thresher performance – trouble shooting and maintenance of power thresher.

18 Calculation output capacity and cost of operation of power thresher.

19 Introduction to grain harvesting equipment – Combine, it's advantages and disadvantages and types

20 Working principles and functional components of combine, study of threshing, separating and cleaning mechanisms of combine

21 Factors affecting the performance combine and cost of combining

22 Combine testing and combine losses, study of combine troubles and troubleshooting

23 Calculation of field capacity, field efficiency, grain losses of combine harvester

24 Chaff cutters, types and capacity calculations

25 Straw combines – working principles and constructional details

26 Introduction to root crop harvesters. Peanut diggers - principle of operation, blade adjustment and approach angle. Peanut digger inverter – operation and adjustments, Study of peanut combine.

27 Potato harvesters – types and constructional details, study of potato combine

28 Introduction to cotton harvesting. Cotton strippers - working principles and constructional details of cotton strippers

29 Cotton pickers - working principles and constructional details of cotton pickers, cotton picker with drum type spindle arrangement and cotton picker with chain belt spindle arrangement

30 Introduction to maize harvesting equipment. Corn combines, corn picker, corn picker-husker and corn picker-sheller, factors affecting corn picker performance, safety rules for corn pickers.

31 Introduction to sugarcane harvesting and study of sugarcane harvester

32 Introduction to vegetables and fruit harvesting equipment and tools

Practical

1 Study of fertilizer broadcasters and weeding equipment

2 Study of sprayers, dusters and measurement of nozzle discharge and field capacity of sprayer

3 Study of various types of impact cutters

4 Study of various types of chaff cutters and forage harvesters

5 Study of various types of mowers, reapers and reaper binder

6 Study of various types of manual harvesting tools

7 Study of various types of groundnut harvesters

8 Study of various types of root crop harvesters

9 Study of various types of combine harvester

10 Calculations of grain losses in combine harvester

11 Study and operation of manual and power operated maize- shellers

12 Study and operation of various types of threshers

13 Study of various types of cotton pickers and strippers

14 Study of various types of fruit harvesting equipment

15 Visit to farm machinery manufacturing industry, advantages of farm machinery centre

16 Practical Examination

References

1. Kepner R.A., Roy Bainer and Barger E.L. 2005. Principles of Farm Machinery. C.B.S Publishers & Distributors Pvt. Ltd., New Delhi.
2. Harris Pearson Smith, 2011. Farm Machinery and Equipment, Morse Press, Lanaken Belgium.
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FMPE 314 Tractor and Farm Machinery Operation and Maintenance 2 (0+2)

Course outlines

Practical

Familiarization with different makes and models of agricultural tractors. Identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems. Study of maintenance points to be checked before starting a tractor. Familiarization with controls on a tractor. Safety rules and precautions to be observed while driving a tractor. Driving practice of tractor. Practice of operating a tillage tool (mould-board

plough/ disc plough) and their adjustment in the field. Study of field patterns while operating a tillage implement. Hitching & De-hitching of mounted and trail type implement to the tractor. Driving practice with a trail type trolley – forward and in reverse direction. Introduction to tractor maintenance, precautionary and break-down maintenance. Tractor starting with low battery charge. Introduction to trouble shooting in tractors. Familiarization with tools for general and special maintenance. Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance of implements – adjustment of functional parameters in tillage implements. Replacement of broken components in tillage implements. Replacement of furrow openers and change of blades of rotavators. Maintenance of cutter bar in a reaper. Adjustments in a thresher for different crops. Replacement of V-belts on implements. Setting of agricultural machinery workshop.

Objectives

To enable the students for acquiring the knowledge pertaining to maintenance of tractors like periodical maintenance and trouble shooting of fuel, lubrication, cooling, ignition systems, etc. and their remedial measures.

Lecture

Practical

1 Familiarization with different makes and models of agricultural tractors

2 Identification of functional systems including fuels system, cooling system

3 Identification of functional systems including transmission system, steering and hydraulic systems

4 Study of maintenance points to be checked before starting a tractor

5 Study of maintenance points to be checked before starting a tractor

6 Familiarization with controls and instrumentation panel on a tractor

7 Familiarization with controls and instrumentation panel on a tractor

8 Safety rules and precautions to be observed while driving a tractor

9 Safety rules and precautions to be observed while driving a tractor

10 Driving practice of tractor

11 Driving practice of tractor with different gears

12 Hitch adjustments of tractor implement

13 Practice of operating a tillage tool (mould-board plough/ disc plough/ Harrow/ Cultivator)

14 Study of field patterns while operating a tillage implement

15 Hitching and De-hitching of mounted type implement to the tractor

16 Hitching & De-hitching trail type implement to the tractor

17 Driving practice with a trail type trolley – forward and in reverse direction

18 Driving practice with a trail type trolley – forward and in reverse direction

19 Introduction to tractor maintenance – precautionary and break-down maintenance

20 Introduction to tractor maintenance – precautionary and break-down maintenance

21 Introduction to trouble shooting in tractors

22 Familiarization with tools for general and special maintenance

23 Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation

24 Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation

25 Safety hints and top end overhauling

26 Fuel saving tips. Preparing the tractor for storage.

27 Care and maintenance procedure of agricultural machinery during operation and off-season

28 Repair and maintenance of implements – adjustment of functional parameters in tillage implements

29 Replacement of broken components in tillage implements. Replacement of furrow openers and change of blades of rotavators

30 Maintenance of cutter bar in a reaper and adjustments in a thresher for different crops

31 Adjustments in a thresher for different crops and replacement of V-belts on implements. Setting of agricultural machinery workshop

32 Practical Examination

References

1. Jagdishwar Sahay. 2015. Elements of Agricultural Engineering. Standard Publishers, New Delhi
2. Nakra C.P., 2009. Farm Machines and Equipments. Dhanpat Rai Publishers, New Delhi
3. Jain SC and CR Rai., 2008. Farm Tractor Maintenance and Repair. Standard Publishers, New Delhi
4. Neil Southorn, Tractors, 1995. Operation, Performance and Maintenance, Inkata Press Australia.

Department of Processing and Food Engineering

PFEN 221 Engineering Properties of Biological Materials 2 (1+1)

Course outlines

Theory

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 and 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. Rheological properties - force, deformation, stress, strain, elastic, plastic and viscous behaviour, Newtonian and non-Newtonian liquid, visco-elasticity, Newtonian and non-Newtonian fluid, Pseudo-plastic, dilatant, thixotropic, rheopectic and bingham plastic foods, flow curves. 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.

Objectives

To enable the students to understand the principles and concepts of various properties of biological materials and to understand the physical laws governing the response of the biological materials to various physical treatments so that the machines, processes and handling operations can be designed for maximum efficiency and the highest quality of the end products.

Lecture

Theory

1 Classification and importance of engineering properties of agricultural produce

2 Shape, size, roundness and sphericity of grains and fruits and vegetables

3 Volume and density of grains and fruits and vegetables

4 Porosity, specific gravity and surface area of grains and fruits and vegetables

5 Thermal properties, heat capacity and specific heat

6 Thermal conductivity, thermal diffusivity, heat of respiration and co-efficient of thermal expansion

7 Friction in agricultural materials - static friction, kinetic friction and rolling resistance

8 Angle of internal friction, angle of repose and flow of bulk granular materials

9 Aero dynamics of agricultural products, drag coefficients and terminal velocity

10 Rheological properties - force, deformation, stress and strain

11 Elastic, plastic and viscous behavior of liquids of Newtonian and non-Newtonian liquid

12 Visco-elasticity of Newtonian and non-Newtonian fluid, Pseudo-plastic and dilatant fluids

13 Thixotropic, rheopectic and bingham plastic foods, flow curves

14 Electrical properties - dielectric loss factor and loss tangent

15 A.C. conductivity and dielectric constant, method of determination

16 Application of engineering properties in handling processing machines and storage structures

Practical

1 Determination of the shape and size of grains

2 Determination of the shape and size of fruits

3 Determination of the shape and size of vegetables

4 Determination of bulk density of grains

5 Determination of angle of repose of grains

6 Determination of the particle density/true density of solid grains

7 Determination of the particle density/true density of solid grains

8 Determination of porosity of solid grains

9 Finding the co-efficient of external and internal friction of different grains

10 Finding out the terminal velocity of grain sample and study the separating behavior in a vertical wind tunnel

11 Finding the thermal conductivity of different grains

12 Finding the thermal conductivity of different grains

13 Determination of specific heat of some food grains

14 Determination of hardness of food material

15 Determination of viscosity of liquid foods

16 Practical Examination

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PFEN 321 Agricultural Structures and Environmental Control 3 (2+1)

Course outlines

Theory

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

Objectives

To impart knowledge on need of environmental control, environmental control systems, farm structures, storage of grain, traditional and modern storage structures, rural water supply, sewage system etc. To enable the students to acquire skills and to understand farm structures design-grain storage etc, and rural development activities.

Lecture

Theory

1 Planning and layout of farmstead, scope, importance and need for environmental control, physiological reactions of human being to live stock, dairy cattle, poultry, sheep and human being

2 Physiological reaction of livestock with environmental factors (influence of climate and thermo regulation, temperature, relative humidity, direct effect of temperature and solar radiation)

3 Environmental control systems and their design

4 Control of temperature, humidity and other air constituents by ventilation and other methods

5 Livestock production facilities - Water, electricity, sanitary requirements

6 BIS standards for dairy, piggery, poultry and other farm structures

7 Design, construction and cost estimation of farm structures

8 Design, construction and cost estimation of animal shelters - dairy barn and poultry farms

9 Design, construction and cost estimation of compost pit, fodder silo

10 Design, construction and cost estimation of fencing and implement sheds

11 Design, construction and cost estimation of barn for cows, buffalo, stable barn, free stalls and milking parlor, barn layout

12 Design, construction and cost estimation of poultry farms. Modern poultry houses, deep litter housing, building of poultry houses, classification - wire floor houses, cage houses

13 Storage of grains, Causes of spoilage

14 Water activity for low and high moisture food and its limits for storage

15 Moisture and temperature changes in grain bins

16 Traditional storage structures and their improvements: Bhukari, Morai, Kothari type storage structures. Requirements for farm machinery and implement shed, requirement of farm workshop, planning and construction of shed and pump house

17 Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins)

18 Design consideration for grain storage structures - traditional, improved, RCC bin

19 Design consideration for bag storage structures - location, plan, dunnage and construction details of different components of storage structure

20 Design consideration for shallow and deep bin

21 Calculation of pressure in bins - grain pressure theories, cost of storage

22 Storage of seeds

23 Rural roads and their construction cost

24 Repair and maintenance rural roads

25 Sources of water supply, norms of water supply for human being and animals

26 Drinking water standards and water treatment suitable to rural community

27 Site and orientation of building in regard to sanitation

28 Community sanitation system

29 Sewage system and its design, cost and maintenance

30 Design of septic tank for small family

31 Estimation of domestic power requirement

32 Source of power supply and electrification of rural housing

Practical

1 Measurements of environmental parameters

2 Measurements for cooling load of a farm building

3 Design and layout of a dairy farm

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

9 Design of grain storage structures

10 Design and layout of commercial bag storage facilities

11 Design and layout of commercial bag storage facilities

12 Design and layout of commercial bulk storage facilities

13 Study and performance evaluation of different domestic storage structure

14 Estimation of a farm building

15 Visit to SWHC

16 Practical Examination

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PFEN 322 Post Harvest Engineering of Cereals, Pulses and Oilseeds 3 (2+1)

Course outlines

Theory

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. 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. 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. 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. By-products utilization.

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.

Objectives

To impart knowledge on various process technologies for cereals, pulses, oilseeds and their conveying and elevating equipment to enable the students to acquire skills and to understand the various processing operations.

Lecture

Theory

1 Cleaning and grading, aspiration, scalping, size separators, screens -screen openings, aperture, screen interval, screen series

2 Sieve analysis, capacity and effectiveness of screens, comparison of actual and idle screen.

3 Various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone, shape graders

4 Size reduction - principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing), crushing efficiency, fineness of ground materials, work index

5 Size reduction machinery - Jaw crusher, Hammer mill, Plate mill, Ball mill, gyratory, smooth roll, attrition mill, burr mill, cutting machinery

6 Material handling equipment. Types of conveyors - Belt, roller, chain and screw, design of belt, roller, chain and screw conveyers, capacity and power requirement calculations

7 Elevators - bucket, Cranes & hoists, trucks (refrigerated/ unrefrigerated), Pneumatic conveying

8 Drying - moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination

9 Psychrometric chart and its use in drying, Drying principles and theory, theory of diffusion, mechanism of drying, factors effecting drying process

10 Thin layer and deep bed drying analysis, falling rate and constant rate drying periods, maximum and decreasing drying rate period

11 Drying equations, mass and energy balance, Shedd's equation, dryer performance

12 Different methods of drying, batch-continuous. Mixing and non-mixing, sun-mechanical, conduction, convection, radiation, superheated steam, tempering during drying

13 Different types of grain dryers - bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray dryers

14 Mixing - Theory of mixing of solids and pastes, Mixing index, rate of mixing, theory of liquid mixing, power requirement

15 Types of mixers for solids, liquid foods and pastes

16 Milling of rice - Conditioning and parboiling, advantages and disadvantages, starch gelatinization methods, parboiling operations, change in chemical constituents during parboiling

17 Traditional methods of parboiling, CFTRI and Jadavpur methods, pressure parboiling method

18 Types of rice mills, modern rice milling, rice milling terminology

19 Different unit operations in milling of rice - cleaning, milling, polishing, grading and packaging

20 Rice milling equipment - rice hullers, Engleburg, centrifugal, under runner, rubber roll sheller, paddy separators, whitening machines

21 Milling of wheat, unit operations and equipment - dry milling and wet milling processes

22 Milling of pulses - traditional milling methods, commercial methods, pre-conditioning - cleaning, conditioning, dehusking, splitting, polishing, milling equipment

23 Dry milling and wet milling methods of pulses - CFTRI and Pantnagar methods, flow charts and equipment

24 Pulse milling machines

25 Milling of corn and its products

26 Dry and wet milling methods of corn, cleaning, conditioning, degerming, reduction classification, germ oil production

27 Milling of oilseeds - mechanical expression, screw press, hydraulic press, radial and axial pressure in barrel

28 Solvent extraction methods, preconditioning of oilseeds

29 Refining of oil, stabilization of rice bran

30 Extrusion cooking - principle, factors affecting extrusion cooking

31 Single and twin screw extruders

32 By-products utilization

Practical

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 and determination of drying constant

9 Determination of EMC (Static and dynamic method)

10 Study of various types of dryers

11 Study of different equipments in rice mills and their performance evaluation

12 Study of different equipments in pulse mills and their performance evaluation

13 Study of different equipments in oil mills and their performance evaluation

14 Type of process flow charts with examples relating to processing of cereals pulses and oil seeds,

15 Visit to grain processing industries

16 Practical Examination

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PFEN 323 Post Harvest Engineering of Horticultural Crops 2 (1+1)

Course outlines

Theory

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). 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, osmodehydration, 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, preservation technology, general methods of preservation of fruits and veg-

etables, 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.

Objectives

To enable the students to acquaint with processing of fruits and vegetables, spices, condiments and flowers, chilling and freezing, dryers for fruits and vegetables, methods of storage, quality control in fruit and vegetable processing industry, preservation methods and packaging materials to increase the shelf life and to minimize the post harvest losses.

Lecture

Theory

1 Importance of processing of fruits and vegetables, spices, condiments and flowers, characteristics and properties of horticultural crops

2 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

3 Blanching - importance and objectives; blanching methods, effects on food (nutrition, colour, pigment, texture)

4 Chilling and freezing - application of refrigeration in different perishable food products, thermophilic, mesophilic and psychrophilic micro-organisms, chilling requirements of different fruits and vegetables

5 Freezing of food, freezing time calculations, slow and fast freezing, equipment for chilling and freezing (mechanical and cryogenic), effect on food during chilling and freezing

6 Cold storage heat load calculations and cold storage design, refrigerated vehicle and cold chain system

7 Dryers for fruits and vegetables – tray dryers, tunnel dryers, conveyor dryers or belt dryers, foam mat drying, fluidized bed dryers, roller or drum dryers, spray dryers, pneumatic dryers, microwave drying, vacuum drying, rotary dryers, freeze dryers. Osmo-dehydration

8 Packaging of horticultural commodities, packaging requirements (in terms of light transmittance, heat, moisture and gas proof, micro organisms, mechanical strength)

9 Different types of packaging materials commonly used for raw and processed fruits and vegetables products - wooden containers, metal, glass containers, plastics in packaging, bulk and retail packages

10 Packaging machines, handling and transportation of fruits and vegetables - road transportation, rail transportation, sea transportation and air transportation. Pack house technology – Reception, drenching, washing, pre-cooling, sorting/grading, waxing

11 Minimal processing, common methods of storage - low temperature storage, evaporative cooled storage, controlled atmospheric storage

12 Modified atmospheric packaging, preservation technology, general methods of preservation of fruits and vegetables – Asepsis, preservation by high temperature, aseptic canning, preservation at low temperature, chemical preservation, preservation by fermentation and preservation by irradiation

13 Brief description, advantages and disadvantages of different physical/ chemical and other methods of preservation, Flowcharts for preparation of different finished products

14 Important parameters and equipment used for different unit operations – cleaning, separation, evaporation, drying, forming, packaging

15 Post harvest management and equipment for spices and flowers – spice extraction, flavouring extracts and their medicinal values

16 Quality control in fruit and vegetable processing industry – quality control measures, good agricultural practices (GAP), requirements and implementation of food supply chain.

Practical

1 Performance evaluation of peeler

2 Performance evaluation of slicer

3 Performance evaluation of juicer

4 Performance evaluation of pulper

5 Performance evaluation of blanching equipment

6 Testing adequacy of blanching

7 Study of cold storage

8 Design of cold storage

9 Study of CAP

10 Study of MAP

11 Minimal processing of vegetables

12 Preparation of value added products

13 Preparation of value added products

14 Visit to fruit and vegetable processing industry

15 Visit to spice processing plant

16 Practical Examination

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PFEN 324 Dairy and Food Engineering 3 (2+1)

Course Outlines

Theory

Deterioration in food products and their controls, physical, chemical and biological methods of food preservation. Nanotechnology - history, fundamental concepts, tools and techniques nanomaterials, applications in food packaging and products, implications, environmental impact of nanomaterials and their potential effects on global economics, regulation of nanotechnology. 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, 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. Dairy plant design and layout. Plant utilities. Principles of operation and equipment for thermal processing, canning, aseptic processing, evaporation of food products - principle, types of evaporators, steam economy, multiple effect evaporation, vapour recompression. 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, non-thermal and other alternate thermal processing in food processing.

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.

Objectives

To impart knowledge on milk and food processing unit operations pasteurization, sterilization, homogenization, packaging, etc. of dairy products and control spoilage of food through process operations such as evaporation, freezing, membrane processing, etc.

Lecture

Theory

1 Deterioration in food products and their controls, causes of food spoilage

2 Principles of food preservation, effect of pH and water content on growth of microorganisms, classification of food with respect to spoilage and consumption

3 Physical, chemical and biological methods of food preservation

4 Dairy development in India - Introduction, statistics of production and consumption

5 Milk composition - composition of different milks - buffalo milk, cow milk, goat or sheep milk, toned milk, skim milk, condensed milk, different Indian dairy products

6 Engineering, thermal and chemical properties of milk and milk products - water content, acidity, pH, developed acidity, natural acidity, total acidity, density, specific gravity, freezing point of milk, colour and flavor of milk

7 Process flow charts for product manufacture - pasteurized milk, Pearson square method, mass balance method for milk standardization

8 Unit operation of various dairy and food processing systems- introduction, sampling, pasteurization, sterilization, packaging, cleaning, grading, evaporation, drying, filtration, clarification, distillation, crystallization, freezing

9 Principles and equipment related to receiving of milk, quality determination, cleaning and disinfection of milk cans and tankers

10 Pasteurization- purpose, methods of pasteurization, pasteurization equipment- batch type, HTST pasteurizer, shell and tube heat exchanger

11 Methods of sterilization, sterilization equipment - batch sterilizer, continuous sterilizer, UHT sterilization. Types of sterilization plants

12 Homogenization – emulsifying, types of emulsions, emulsifiers, application, mode of operation, effect on the product

13 Centrifugation and cream separation- working of disc bowl centrifuge, working of cyclone separator

14 Preparation methods and equipment for manufacture of cheese

15 Preparation methods and equipment for manufacture of paneer

16 Preparation methods and equipment for manufacture of butter

17 Preparation methods and equipment for manufacture of butter, ice-cream

18 Filling and packaging of milk and milk products - packaging of milk, cultured milk, cheese, butter, concentrated milk products, dried milk products

19 Dairy plant design and layout - factors in planning, importance of site selection, location of building, size and type of dairy building, advantages of good plant layout, functional design

20 Plant utilities requirement - electricity, water and power requirement

21 Principles of operation and equipment for thermal processing, canning, aseptic processing.

22 Evaporation of food products - principle, factors affecting rate of evaporation, boiling point elevation

23 Types of evaporators - natural circulation evaporators- batch type, horizontal short tube, vertical short tube, long tube, forced circulation evaporator, agitated film evaporator

24 Steam economy, single and multiple effect evaporation, vapour recompression systems

25 Drying of liquid and perishable foods: principles of drying, sorption isotherms, hysteresis, drying process, drying rate

26 Drying methods - spray drying, working principle of cyclone separator, drum drying, freeze drying, dielectric drying, foam mat drying, fluidized bed drying, rotary dryer

27 Filtration - principle, types of filters, membrane separation, Reverse Osmosis (RO)

28 Nano-filtration, ultra filtration and micro-filtration, equipment and applications

29 Non-thermal and other alternate thermal processing in food processing - high pressure processing

30 Nanotechnology - history, fundamental concepts, tools and techniques of different nanomaterials

31 Applications of nano-materials in food packaging and products, implications.

32 Environmental impact of nano-materials and their potential effects on global economics, regulation of nanotechnology

Practical

1 Study of various pasteurizers and their working
2 Study of various sterilizers and their working
3 Study of homogenizer and its working
4 Study of cream separator and its working
5 Study of butter churns
6 Study of evaporators and their working
7 Study of milk dryers and their working
8 Study of freezer and its working
9 Study of different filtration equipment
10 Design of food processing plants
11 Preparation of food plant layout
12 Visit to multi-product dairy/food plant
13 Estimation of steam requirements
14 Estimation of refrigeration requirements in dairy & food plant
15 Visit to Food industry
16 Practical Examination

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Department of Irrigation and Drainage Engineering

IDEN 231 Ground Water, Wells and Pumps 3 (2+1)

Course outlines

Theory

Occurrence and movement of ground water; aquifer and its types; classification of wells, fully penetrating tube wells and open wells, familiarization of various types of bore wells; design of open wells; groundwater exploration techniques; methods of drilling of wells: percussion, rotary, reverse rotary; design of tube well and gravel pack, installation of well screen, completion and development of well; ground water hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow's, Theis recovery method; well interference, multiple well systems, estimation of ground water potential, quality of ground water; artificial ground water recharge techniques; 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; Cost economics of motor and pump sets.

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's method; Theis Recovery method; well design under confined and unconfined conditions; well losses and well efficiency; 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; testing of centrifugal pump and study of cavitations; study of hydraulic ram; study and testing of submersible pump; Cost economics of motor and pump sets.

Objectives

To introduce the ground water hydrology to the under graduate students in order to provide knowledge about the aquifers, wells and pumps and its characteristics and to impart the skills in design of various wells, pumps according to the site situations in India.

Lecture

Theory

1 Introduction - role of ground water in water resources - global water scenario - water resources status in India – water budget in India - classification of ground water and it's vertical distribution - occurrence and movement of ground water

2 Aquifer – it's types - unconfined aquifer, confined aquifer, leaky aquifer and idealized aquifer - diagrammatic representation

3 Classification of wells - based on type of aquifer, depth of the well and method of construction of the well - types of flows in wells - fully penetrating tube wells and open wells, familiarization of various types of bore wells

4 Design of open wells – site for an open wells and it's types – design procedure for open wells

5 Ground water replenishment and methods of ground water recharge - ground water exploration techniques - Test drilling, geophysical methods, electrical resistivity method, gamma ray logging, electrical resistivity surveying, seismic refraction surveying

6 Methods of drilling of wells - percussion, rotary, reverse rotary - common drilling difficulties

7 Design of tube well - well diameter and yield, size of the casing pipe and well screen, well depth, length of well screen

8 Deign of Gravel packing - installation of well screen and it's types, losses and material of the well screens - completion and well development

9 Ground water hydraulics - static water level - piezometric water level-pumping water level, drawdown, area of the influence and well yield -aquifer characteristics influencing yield of wells - hydraulic conductivity and transmissibility

10 Determination of aquifer parameters – steady state flow through unconfined aquifers and confined aquifers - Dupit Thiem equations

11 Determination of aquifer parameters under unsteady state conditions in confined aquifer by Theis method

12 Chow's method for finding out aquifer parameters in confined aquifer under unsteady state condition

13 Jacob method – Theis recovery test for unsteady state aquifer

14 Well interference and it's design - multiple well systems

15 Estimation of ground water potential

16 Quality of ground water and suitability for irrigation

17 Artificial ground water recharge techniques - direct method, indirect method and combination methods

18 Pumping systems and water lifting devices, classification of pumps – Indigenous water lifting devices such as swing basket, don, Archimedean screw, water wheel, persian wheel, chain pump, rope and bucket lift

19 Wind powered water lifts, solar powered and biogas operated water lifts

20 Reciprocating Pumps - single and double acting pumps and problems on reciprocating pumps

21 Components of centrifugal pumps - volute and diffuser principles and diagrammatic representation - classification of centrifugal pumps based on the different criteria - necessity of priming

22 Terminology and problems on horse power - water horse power, shaft horse power, brake horse power, kilowatt input to motor with drive efficiency and motor efficiency

23 Selection of pump - installation, trouble shooting of pumps and design of centrifugal pumps

24 Performance curve, effect of speed on capacity, head, power and efficiency curves

25 Effect of change of impeller dimensions on performance or characteristics and related problems

26 Hydraulic ram and it's working principle

27 Propeller pumps and mixed flow pumps and their performance characteristics

28 Mixed flow pumps their performance characteristics

29 Jet pumps and air lift pumps with their working principle

30 Deep well turbine pump - construction, installation and maintenance

31 Submersible pumps - construction, installation and maintenance

32 Cost economics of motor and pump sets – fixed costs, variable costs, operational cost

Practical

1 Verification of Darcy's law

2 Study of different drilling equipments

3 Sieve analysis for gravel and design of well screen

4 Estimation of specific yield and specific retention

5 Study on testing of well screen

6 Estimation of aquifer parameters by Theis method, Coopers-Jacob method, Chow's method and Theis Recovery method

7 Well design under confined and unconfined conditions

8 Study on well losses and well efficiency

9 Estimating groundwater potential based on ground water balance

10 Study of artificial ground water recharge structures

11 Study of radial flow and mixed flow centrifugal pumps

12 Study of multistage centrifugal pumps, turbine, propeller and other Pumps

13 Installation of centrifugal pump, turbine and submersible pumps

14 Testing of centrifugal pump, submersible pump and study of cavitations

15 Problems on cost analysis of pumping systems

16 Practical Examination

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1. Michael AM, Khepar SD. and SK Sondhi. 2008. Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill, New Delhi.
2. Todd David Keith and Larry W. Mays. 2004. Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow).
3. Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II, 5th Edition. Jain Brothers Publication, New Delhi.
4. Michael AM. 2014. Irrigation Theory and Practice, 2th Edition. Vikas Publishing house Pvt. Ltd, New Delhi.

IDEN 232 Irrigation Engineering 3 (2+1)

Course outlines

Theory

Major and medium irrigation schemes of India, purpose of irrigation, environmental impact of irrigation projects, source of irrigation water, present status of development and utilization of different water resources of the country. Measurement of irrigation water - weir, flumes and orifices and other methods. 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. 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, water and irrigation requirement of crops, depth of irrigation, frequency of irrigation, irrigation efficiencies. Surface methods of water application - border, check basin and furrow irrigation methods and their adaptability, specifications 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, field capacity and wilting point. Estimation of evapotranspiration. Land grading methods. 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.

Objectives

To provide knowledge and exposure about various concepts of irrigation projects including efficiencies. Also to enrich and acquaint the students in design of crop and irrigation water

requirements, different surface irrigation methods and open channel, lined and unlined channel. To make the students to able to design any field with suitable irrigation systems.

Lecture

Theory

1 Introduction - Irrigation development and classification of irrigation project-major, medium and minor irrigation schemes of India.

2 Environmental impact of irrigation projects, source of irrigation water, present status of development and utilization of different water resources of the country

3 Irrigation terminology - GCA, CCA, base period, crop period, delta, duty, relationship between duty and delta

4 Irrigation Engineering - purpose of irrigation and advantages of irrigation

5 Measurement of irrigation water – units of measurements, methods of measurement, direct measurement of velocity by using the current meter and indirect methods viz. area–velocity method, ordinate method for measuring discharges from the pipes, dethridge meter and tracer methods

6 Direct measurement of discharges through the different devices such as weir, flumes and orifices and other methods

7 Open channel water conveyance system - methods of conveyance of irrigation water

8 Design capacity of open channel – velocity and discharge of flow in open channel, lining and un lining of irrigation field channels

9 Design capacity of open channel using Lacey's and Kennedy's theories and related problems

10 On farm structures for water conveyance, structures to control erosion in irrigation channel - drop structure, pipe drop structure and chute spillways.

11 Water control - check gates, portable check gate, diversions and others

12 Lining canals, lining materials – Cement concrete lining, bricks with sandwiched mortar lining, LDPE film

13 Underground pipe line water distribution system – types of pipes used for underground pipe lines, reinforced and non-reinforced concrete pipes. Testing of the pipe line and estimation of discharge capacity of pipelines

14 Design and installation of underground pipeline systems and common troubles of pipelines

15 Land grading - criteria for land leveling, soil profile condition, land slope, rainfall characteristics, cropping pattern, irrigation methods, and other conditions

16 Land leveling design methods - plane method and profile method

17 Land leveling design methods - plane inspection method and others

18 Estimation of earth work - end area method

19 Introduction to soil – water - plant relationship - soil physical properties such as soil texture, soil structure, capillary conductivity, soil consistency and volume- mass relationships of constituents.

20 Soil properties influencing the irrigation management, kinds of soil water, soil water movement- infiltration, accumulated infiltration rate, factors affecting the infiltration rate, measurement of infiltration in the field and by using the curve fitting method

21 Soil water potential - gravitational potential, pressure potential, matric potential and osmotic potential

22 Soil moisture characteristics curve, soil moisture constants such as saturation capacity, field capacity, moisture equivalent and permanent wilting point and rooting characteristics and moisture use of crops

23 Terminology related with the movement of water within soils - water intake, percolation, interflow, seepage, permeability, hydraulic conductivity and hydraulic gradient, measurement of soil moisture - gravimetric method, tensiometers, pressure membrane and pressure plate apparatus and others

24 Moisture movement under saturated conditions and unsaturated conditions of the soil. Moisture stress and plant response

25 Evaporation, transpiration and concept of Evapotranspiration (ET) and estimation of ET- Blaney-criddle, Thornthwaite, Penman and modified Penman and Penman- Monteith equations and potential ET (PET)

26 Water and irrigation requirement of crops - importance of water in plant growth, procedures for working out the net irrigation requirement (depth of irrigation), gross irrigation requirement, irrigation frequency

27 Irrigation efficiency - conveyance, application, storage, distribution and water use efficiency and related problems

28 Surface methods of water application - classification, border, check basin and furrow irrigation methods and their advantages and disadvantages

29 Border irrigation – components of border irrigation- width, length and slope for different soils and adaptability, hydraulics of border irrigation

30 Design of border irrigation and derivation of Israelson' equation for the width of the border

31 Check basin irrigation – advantages and disadvantages, determination of infiltration under check basin conditions, adaptability and design consideration

32 Furrow irrigation system - advantages and disadvantages, estimation of infiltration depth in furrows by inflow and outflow method.

Practical

1 Measurement of soil moisture by different soil moisture measuring instruments

2 Measurement of irrigation water using weir, flume and orifice

3 Measurement of infiltration characteristics by using the double infiltrometer
4 Determination of bulk density, field capacity and wilting point and related problems
5 Measurement of evapotranspiration
6 Exercises on Land grading methods
7 Design of underground pipeline system
8 Problems on irrigation efficiencies
9 Study of advance, recession and computation of infiltration opportunity time
10 Design of border irrigation system
11 Design of furrow irrigation using inflow-outflow method
12 Evaluation of check basin irrigation method
13 Study on use of current meter and water meter
14 Visit to nearby water user associations
15 Visit to nearby the irrigation projects
16 Practical Examination

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2. Majumdar D. K. 2013. Irrigation Water Management Principles. PHI learning Pvt. Ltd. New Delhi.
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IDEN 331 Sprinkler and Micro Irrigation Systems 2 (1+1)

Course outlines

Theory

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. Selection of pump and power unit for sprinkler irrigation system. Performance evaluation of sprinkler irrigation system - uniformity coefficient and pattern efficiency. Micro Irrigation Systems- types like drip, spray, & bubbler systems, merits and demerits, different components. Design of drip irrigation system - general considerations, wetting patters, irrigation requirement, emitter selection, hydraulics of drip irrigation system, design steps.

Necessary steps for proper operation of a drip irrigation system. 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.

Objectives

To impart knowledge and skills to students to design sprinkler and drip irrigation systems and enable them to understand installation, operation and maintenance and cost economics of micro-irrigation systems

Lecture

Theory

1 Sprinkler irrigation – Historical development. Scenario in the World, Country and State, adoptability and limitations

2 Factors affecting the performance of Sprinkler irrigation

3 Types of sprinkler irrigation systems - Based on sprinkling mechanism and portability

4 Components of the sprinkler system - pump set, main lines, lateral lines, sprinkler heads, debris screens, desilting basins, booster pumps, take-off valves, flow control valves, fertigation equipment

5 Moisture distribution patterns, recommended sprinkler spacing, effect of wind speed on working of the system, importance of distribution uniformity, Chrstiansen uniformity coefficient

6 Design of sprinkler system, layout, laterals and mains - inventory of resources and conditions, types of system and layout, sprinkler selection and spacing, capacity of sprinkler systems, hydraulic design of sprinkler systems and selection of pump and power unit

7 Operation and maintenance of system and cost analysis

8 Micro Irrigation systems – Types like drip, spray and bubbler systems

9 Drip irrigation – Historical development, scenario in the world, country and state, advantages and limitations

10 Components of drip irrigation - head control system, water carrier system andwater distribution system

11 Types of emitters and their discharge equation, types of filters and other important components

12 Design of drip irrigation system - general considerations, wetting patters, irrigation requirement, emitter selection

13 Manufacturing coefficient of variation and emission uniformity, hydraulics of drip irrigation system and design steps

14 Necessary steps for proper installation and operation of a drip irrigation system. Maintenance of micro irrigation system - clogging problems, filter cleaning, flushing and chemical treatment

15 Fertigation - advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system

16 Fertigation frequency, duration and injection rate, methods of fertigation

Practical

1 Study of different components of sprinkler irrigation system

2 Design and installation of sprinkler irrigation system

3 Determination of precipitation pattern, discharge and uniformity coefficient

4 Cost economics of sprinkler irrigation system

5 Tutorial class on design of sprinkler irrigation

6 Field visit to nearby places for studying sprinkler system

7 Study of different components of drip irrigation

8 Design and installation of drip irrigation system

9 Determination of pressure discharge relationship and emission uniformity for given emitter

10 Study of different types of filters and determination of filtration efficiency

11 Determination of rate of injection and calibration for chemigation/fertigation

12 Design of irrigation and fertigation schedule for crops

13 Cost economics of drip irrigation system

14 Tutorial class on design of drip irrigation system

15 Field visit of drip irrigation system and evaluation of drip system

16 Practical Examination

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IDEN 332 Drainage Engineering 2 (1+1)

Course Outlines

Theory

Water logging - causes and impacts. Drainage - objectives of drainage, familiarization with the drainage problems of the state. 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, design of subsurface drainage system, drainage materials - drainage pipes and drain envelope, layout, construction and installation of drains. Drainage structures - 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 iso¬bar maps. Determination of drainable porosity. Design of surface drainage systems. Design of gravel envelop. Design of subsurface drainage systems. Determination of chemical properties of soil and water. Study of drainage tiles and pipes. Installation procedure of sub-surface drainage system. Cost analysis of surface and sub-surface drainage system.

Objectives

To enable the students to design and execute proper surface and sub-surface drainage systems in salt affected and water logged areas in agricultural lands and to improve land productivity by controlling the twin problems of water logging and salinity and thereby to enhance the crop production and productivity

Lecture

Theory

1 Drainage - definition, objectives and types, familiarization with the drainage problems (twin problems of water logging and salinity) and extent of areas in irrigated areas in the state

2 Water logging – causes of water logging and impacts. Surface drainage - effects of poor drainage, areas requiring drainage, factors affecting drainage requirement, drainage coefficient, determination of drainage coefficient based on different criteria

3 Types of surface drainage - random field drain system, bedding system, parallel field drain, parallel lateral open ditch, cross slope drain system interception system, design of open drainage channels using Manning's equation and alignment of open ditches (radius of curvature)

4 Investigations on design parameters, hydraulic conductivity, drainable porosity, fluctuations of depth to water table in the areas, methods of determining hydraulic conductivity by single auger hole method and derivation of Hooghoudt's equation for 'K' with assumptions and inverse auger hole

5 Sub-surface drainage systems - purpose and benefits, types of sub-surface systems - tile drains, mole drains, drainage wells, deep open drains and combinations and their suitability for different conditions and limitations

6 Components of sub-surface drainage system- layouts and types- Random type, herring bone, grid iron, cutoff or interceptor drains, depth and spacing of drains, size of the pipe drains using Manning's equation, drain materials of burnt clay, perforated corrugated and solid PVC and cement concrete, slope/grade for the drains

7 Envelope materials for sub-surface drains and selection criteria for uniform soils and graded soils, geo-textile and nylon mesh, outlets for sub-surface drainage, gravity and pumped outlets

8 Design of sub-surface drains under steady state (equilibrium) conditions and derivation of Hooghoudt's equation for spacing S = ((4K/i) (b2 – d2))0.5 and its limitations and equivalent depth concept

9 Derivation of Ellipse (Hooghoudt's) equation Q L2 = 8 Kb d (Di - Dd) (Dd - Dw) + 4 Ka (Dd - Dw)2

10 Derivation of The Ernst's drain spacing (L) equation as combination of horizontal, vertical and radial flows

11 Glover-Dumm equation (only) for spacing under non-steady state conditions of water table to drop from 'm_0' to 'm' in time 't'

12 Drainage structures, loads on conduits, ditch conduit conditions and projecting conduit conditions

13 Construction and installation of drainage system

14 Bio-drainage, vertical drainage and drainage of irrigated and humid areas. Conjunctive use of fresh and saline water

15 Salt balance, classification and reclamation of saline and alkaline soils, soil amendments, leaching requirement- leaching ratio- LR = , changes in soil salinity levels with evaporation of ground waters

16 Economic aspects of drainage with a typical example for total cost estimation of SSD system and benefit-cost ratio

Practical

1 Field In-situ measurement of hydraulic conductivity by single auger hole method

2 Field In-situ measurement of hydraulic conductivity by inverse auger hole method

3 Installation of piezometer and observation well

4 Preparation of iso-bath and iso-bar maps

5 Determination of chemical properties of soil and water

6 Design of surface drainage system

7 Determination of drainage coefficient

8 Design of subsurface drainage system

9 Determination of loads on projecting type conduits and ditch type conduits

10 Determination of drainable porosity

11 Problems on salinity control and leaching requirements

12 Visit to nearby surface and subsurface drainage systems

13 Design of outlets & gravel envelop

14 Cost analysis of surface and subsurface drainage systems

15 Working on a case study of nearby problematic area

16 Practical Examination

References

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Department of Soil and Water Conservation Engineering

SWCE 241 **Watershed Hydrology** **2 (1+1)**

Course outlines

Theory

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. 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. Stream gauging - discharge rating curves, flood peak, design flood and computation of probable flood. 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.

Objectives

To enable the students to acquire knowledge and skills on hydrological (rainfall and runoff) measurements in watersheds, hydrological design of structures, prediction of volume and rates of runoff with tools like hydrographs and unit hydrographs, reservoir planning with flood routing techniques for application in natural resources management

Lecture

Theory

1 Hydrology - definition, hydrologic cycle and it's components. Forms of precipitation and measurement of precipitation – recording and non-recording rain gauges

2 Rain gauge network, preparation of rainfall data and mean precipitation over an area

3 Point rainfall, frequency analysis of point rainfall, Mass curve, Hyetograph, Depth-area-duration and Intensity-duration-frequency relationships

4 Definition of interception, infiltration and factors influencing and determination of net effective rainfall - infiltration indices - Phi index and W- index

5 Evaporation and it's process, method of estimating lake evaporation -Types of evaporimeters, measures to reduce lake evaporation, Soil evaporation

6 Runoff – definition - components of runoff - direct runoff and base flow, overland flow and interflows, runoff characteristics of streams, factors affecting runoff - climatic factors and physiographic factors

7 Runoff estimation methods - Rational method, Cook's method and SCS curve number method

8 Geomorphology of watersheds – Linear, aerial and relief aspects of watersheds - stream order, drainage density and stream frequency

9 Hydrographs - definition and components, factors affecting flood hydrograph, hydrograph separation for simple and complex storms -straight line method and other methods

10 Unit hydrographs - concept and the three implications of the definition and the two basic assumptions (linear response and time invariant), Derivation of unit hydrographs from total hydrograph, average unit hydrographs from several storms of the same duration

11 Derivation of unit hydrograph for complex storms, the conversion of unit hydrograph duration, methods for unit hydrographs of different durations -method of superposition and S - Curve method

12 Synthetic unit hydrograph - need and concept, Snyder's synthetic unit hydrograph, formulae relating hydrograph features - basin lag, peak flow and time base of the unit hydrograph

13 Stream gauging - discharge rating curves, direct and indirect methods for determination of stream discharge, flood peak, design flood and computation of probable flood.

14 Flood routing - introduction, basic equation, two broad categories of flood routing

15 Reservoir routing and channel routing

16 Drought - classification, causes and impacts, drought management strategy

Practical

1 Visit to meteorological observatory and study of different instruments

2 Design of rain gauge network

3 Exercise on intensity-duration-frequency 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 hydrological data and estimation of missing data, test for consistency of rainfall records

7 Exercise on computation of infiltration indices

8 Computation of peak runoff and runoff volume by Cook's method and rational method

9 Computation of runoff volume by SCS curve number method

10 Study of stream gauging instruments - current meter and stage level recorders

11 Exercise on geomorphic parameters of watersheds

12 Exercise on runoff hydrographs

13 Exercise on unit hydrograph

14 Exercise on synthetic hydrograph

15 Exercise on flood routing

16 Practical Examination

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SWCE 242 Soil and Water Conservation Engineering 3 (2+1)

Course outlines

Theory

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. Soil loss estimation – Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity - estimation by KE>25 and EI30 methods. Soil erodibility - topography, crop management and conservation practice factors. Measurement of soil erosion - runoff plots, soil samplers. Water erosion control measures - agronomical measures viz. 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. Wind erosion- factors affecting, mechanics, soil loss estimation and control measures, vegetative and mechanical measures, wind breaks and shelter belts, stabilization of sand dunes. Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks.

Practical

Study of different types and forms of water erosion. Exercises on computation of rainfall erosivity index. Computation of soil erodibility index in soil loss estimation. 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. Study of rainfall simulator for erosion assessment. Estimation of sediment rate using Coshocton wheel sampler and multi-slot devisor. Determination of sediment concentration through oven dry method. Design and layout of contour bunds. Design and layout of graded bunds. Design and layout of broad base terraces. Design and layout of bench terraces. Design of vegetative waterways. Exercises on rate of sedimentation and storage loss in tanks. Computation of soil loss by wind erosion. Design of shelterbelts and wind breaks for wind erosion control. Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures.

Objectives

To enable the students to acquire knowledge on different soil loss estimation models, runoff estimation by rational, curve number, Cook's formulae, land use capability classification, land treatment works like contour bunding, terracing, bench terraces, contour trenches and their types and complete design calculations. Also to enrich and familiarize the students in the design of various gully control structures, temporary and permanent, their designs with a due importance to hydrologic, hydraulic and structural phases of design.

Lecture

Theory

1 Introduction- Soil and Water Conservation Research Centre, it's sub-centers in India and soil conservation programmes in India

2 Causes and agents of erosion, factors affecting erosion and effects of soil erosion

3 Soil Erosion - geologic, accelerated erosion, water erosion, forms of water erosion splash, rill, sheet, gully, ravines and stream bank erosion

4 Mechanics of water erosion - hydraulic action, abrasion, attrition, saltation, transportation and deposition

5 Gullies and their classification, stages of gully development

6 Soil loss estimation - Universal Soil Loss Equation (USLE) and modified soil loss equation, A= RKLSCP, expansion of various terms and estimation of their various parameters.

7 Rainfall erosivity - estimation by KE>25 and EI 30 methods

8 Soil erodibility - topography, crop management and conservation practice factors, Modified USLE

9 Measurement of soil erosion - runoff plots, soil samplers - multislot devisor, Coshocton wheel sampler

10 Land use capability classification based on different criteria with a special reference to slope

11 Erosion control measures - agronomic measures - contour farming, strip cropping, conservation tillage and mulching

12 Erosion control measures - mechanical or engineering measures – bunds, terraces, trenches

13 Classification of bunding system, Contour bunds - design of contour bunds-horizontal interval-vertical interval-cross section of the contour bunds - seepage line consideration

14 Contour bunds - design of contour bunds - length of contour bund, earth work of contour bund

15 Determination height of bund - loss of area due to bunding. Construction of contour bunds in field.

16 Graded bunds - design of graded bunds, construction and alignment of bunds. Design of surplus arrangements

17 Terraces- classification of terraces –level and graded terraces, narrow based and broad based terraces

18 Contour stone wall/stone terracing, measures for controlling land slides

19 Design of graded terrace, runoff from terrace, terrace channel capacity

20 Bench terraces- types of bench terraces, planning, design of bench terraces, derivation of vertical interval, terrace width and gradient

21 Layout procedure for bench terraces, alignment, area lost for cultivation

22 Graded terrace construction and maintenance

23 Contour trenching - staggered and continuous trenches, their adaptability and types.

24 Principles of gully control – stabilization of gully head, vegetative measures and diversion drains

25 Temporary gully control structures – types like brush wood dams- wire mesh dams. Introduction to Permanent gully control structures - components of permanent structures and design.

26 Vegetated waterways - types of water ways based on shapes, expressions for wetted perimeters, areas, hydraulic radius, types of vegetation, roughness of different grasses and design of vegetated waterways

27 Wind erosion - factors affecting wind erosion and mechanics of wind erosion

28 Soil loss estimation, wind erosion control measures - vegetative, mechanical measures

29 Wind breaks & shelter belts, sand dunes stabilization

30 Sedimentation - sedimentation in reservoirs and streams, estimation and measurement, sediment delivery ratio

31 Trap efficiency, silt monitoring and storage loss in tanks

32 Estimation of useful life of reservoir based on sedimentation

Practical

1 Study of different types and forms of water erosion

2 Problems on USLE. Soil loss estimation using erosivity index and erodibility index

3 Determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE and MUSLE.

4 Study of rainfall simulators for erosion assessment

5 Estimation of soil loss from runoff plots

6 Estimation of soil loss using Coshocton silt sampler & Multi slot divisor

7 Design of contour bunding system

8 Design of graded bunding system

9 Design and layout of broad based terraces

10 Design and layout of bench terracing systems

11 Determination of rate of sedimentation and storage loss in reservoir/tanks

12 Design of vegetated water ways in the field

13 Computation of soil loss by wind erosion

14 Design of shelter belts and wind breaks

15 Field visit to study different soil conservation structures & gully control structures

16 Practical Examination

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6. Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service, New Delhi.
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SWCE 341 Watershed Planning and Management 2 (1+1)

Course outlines

Theory

Watershed - introduction and characteristics. Watershed development - problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present 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. 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. Planning and formulation of project proposal for watershed management programme including cost-benefit analysis.

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. Techno-economic viability analysis of watershed projects. Visit to watershed development project areas.

Objectives

To train the students in the multi disciplinary subject of watershed management for effective conservation of land, using engineering and agronomic practices, control of soil loss in watershed, participatory management teams in small as well as large watersheds for increasing the productivity and preparation of necessary project proposals.

Lecture

Theory

1 Watershed – introduction, concept and characteristics. Watershed development –watershed area, command area and identification of watershed problems and prospects

2 Major investigations on topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors

3 Watershed management - concept, objectives, factors affecting, watershed planning based on land capability classes

4 Geomorphology of watersheds - size and shape of watershed, slope, order, number of streams in a basin, stream pattern and others

5 Evolution of effects of watershed management treatments - statistically, hydrological sediment yield and scatter diagrams

6 Hydrologic data for watershed planning, watershed codification, delineation and prioritization of watersheds

7 Sediment yield – factors affecting the sediment yield, measurement of sediment yield, sediment yield index, controlling sedimentation, water budgeting in a watershed

8 Management measures - rainwater conservation technologies - in-situ and ex-situ storage, water harvesting and recycling, their advantages and benefits

9 Dry farming techniques - inter-terrace and inter-bund land management. Forest plantation – terracing, surface cover brushwood and planting

10 Integrated watershed management – concept, objectives, components, arable lands - agriculture and horticulture, non-arable lands - forestry, fishery and animal husbandry

11 Effect of cropping systems, land management and cultural practices on watershed hydrology

12 Watershed programme – execution, project implementation and evaluation, follow-up practices, characteristics of forest watersheds, forest plantation, streams and soils

13 Watershed programme – maintenance and control measures, monitoring, evaluation and reporting

14 Participatory watershed management - role of watershed associations, user groups and self-help groups

15 Planning of project proposal for watershed management programme including cost-benefit analysis

16 Formulation of project proposal for watershed management programme including cost-benefit analysis

Practical

1 Exercises on delineation of watersheds using toposheets

2 Surveying and preparation of watershed map

3 Quantitative analysis of watershed characteristics

4 Quantitative analysis of watershed parameters

5 Watershed investigations for planning and development

6 Analysis of hydrologic data for planning watershed management

7 Water budgeting of watersheds

8 Prioritization of watersheds based on sediment yield index

9 Study of functional requirement of watershed development structures

10 Study of watershed management technologies

11 Practice on softwares for analysis of hydrologic parameters of watershed

12 Study of role of various functionaries in watershed development programmes

13 Techno-economic viability analysis of watershed projects

14 Visit to watershed development project areas

15 Visit to watershed development project areas

16 Practical Examination

References

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SWCE 342 Water Harvesting and Soil Conservation Structures 3 (2+1)

Course outlines

Theory

Water harvesting - principles, importance and issues. Water harvesting techniques - classification based on source, storage and use. Runoff harvesting – short-term and long-term techniques. Short-term harvesting techniques - terracing and bunding, rock and ground catchments.

Long-term harvesting techniques - purpose and design criteria. Structures - farm ponds (dug-out and embankment reservoir types), tanks and subsurface dykes. 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. 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. Hydraulic jump and its application. 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. 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. 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.

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. Runoff measurement using H-flume. 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 softwares for design of soil and water conservation structures. Field visit to watershed project areas treated with soil and water conservation measures / structures.

Objectives

To enable the students to acquire knowledge on rain water harvesting and storage, land treatment works and their complete design. Also to enrich and familiarize the students in the design of various soil erosion control structures with a due importance to hydrological, hydraulic and structural phases of design.

Lecture

Theory

1 Water harvesting – principles, advantages and disadvantages of water harvesting, importance and issues

2 Water harvesting techniques - classification based on source, storage and use

3 Runoff harvesting – short-term and long-term techniques

4 Short-term harvesting techniques - terracing, bunding, rock ground catchments and mechanical measurements

5 Long-term harvesting techniques - purpose and design criteria

6 Structures - farm ponds (dug-out and embankment reservoir types), tanks and subsurface dykes

7 Farm pond - components, site selection, design criteria and capacity

8 Earth Embankment – types, site selection, construction details of embankment, design criteria, seepage analysis, calculation of capacity

9 Emergency spillways - design and cost estimation, construction

10 Percolation pond - site selection, design and construction details, design considerations of nala bunds

11 Soil erosion control structures - introduction, classification and functional requirements

12 Permanent erosion control structures uses – advantages, adaptabilities and limitations

13 Stages of gully development, classification of gullies methods for gully control, check dams - types of check dams

14 Types of permanent structures - drop spillways, chute and drop inlet spillways

15 Drop spillways – uses, guidelines for selection and construction details

16 Design of drop spillways for gully control - hydrologic, hydraulic and structural design and related problems

17 Design of chute spillways for gully control - hydrologic, hydraulic and structural design, planning for design of the spillways

18 Drop inlet spillways – uses, requirements and planning for design of the spillways and related problems

19 Gully control measures - causes and process gully

20 Hydraulic jump - advantages of hydraulic jump, jump in channels, energy loss equation, height of jump and length of the jump, classification of jump and its application related problems on energy loss

21 Drop spillway - applicability, types - straight drop, box type inlet, straight apron and stilling basin outlet, functional use of drop spillways, advantages and disadvantages of the spillways

22 Description of box-type inlet spillways - hydraulic design of box-type inlet spillways and related problems

23 Description of straight apron and stilling basin outlet

24 Design of straight apron and stilling basin outlet and related problems

25 Structural components and functions of drop spillways

26 Loads on head wall, variables affecting equivalent fluid pressure

27 Triangular load diagram for various flow conditions

28 Creep line theory in a load diagram

29 Uplift pressure estimation, safety against sliding, overturning, crushing and tension on spillways

30 Chute spillway - description, components, energy dissipaters

31 Design criteria of Saint Antony Falls (SAF) stilling basin and its limitations

32 Drop inlet spillway - description, functional use, design criteria of the drop inlet spillway

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

5 Design of nala bunds

6 Runoff measurement using H-flume

7 Tutorials on hydraulic jump and energy dissipation in water flow

8 Tutorials on hydrologic, hydraulic and structural design of drop spillway and stability analysis.

9 Design of SAF stilling basins in chute spillway.

10 Tutorial on hydrologic, hydraulic and structural design of drop inlet spillway

11 Design of small earthen embankment structures

12 Practice on soft-wares for design of soil and water conservation structures.

13 Field visit to watershed project areas treated with soil conservation measures

14 Field visit to water harvesting measures

15 Field visit to water conservation structures

16 Practical Examination

References

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Department of Renewable Energy Engineering

REEN 251 Fundamentals of Renewable Energy Sources 3(2+1)

Course outlines

Theory

Concept and limitation of Renewable Energy Sources (RES), Criteria for assessing the potential of RES, Classification of RES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of renewable energy sources with non renewable sources. Solar Energy: Energy available from Sun, Solar radiation data, solar energy conversion into heat through, Flat plate and Concentrating collectors, different solar thermal devices, Principle of natural and forced convection drying system, Solar Photo voltaics: p-n junctions. Solar cells, PV systems, Stand alone, Grid connected solar power station, Calculation of energy through photovoltaic power generation and cost economics. Wind Energy: Energy available from wind, General formula, Lift and drag. Basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Types of Windmill rotors, Determination of torque coefficient, Induction type generators, Working principle of wind power plant. Bio-energy: Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification, Types of gasifier, various types of biomass cook stoves for rural energy needs. Biogas: types of biogas plants, biogas generation, factors affecting biogas generation and usages, design consideration, advantages and disadvantages of biogas spent slurry.

Practical

Study of different types of solar cookers, solar water heating system, natural convection solar dryer, forced convection solar dryer, solar desalination unit, solar greenhouse for agriculture production, biogas plants, biomass gasifiers, biomass improved cook-stoves, solar photovoltaic system

Objectives

To enable the students to know about the basic principles of different Renewable energy sources like Solar, Wind, Geothermal, Biomass, Ocean energy sources and their concepts, benefits and limitations

Lecture

Theory

1 Concept and limitation of Renewable Energy Sources (RES): importance of renewable energy sources

2 Criteria for assessing the potential of RES.

3 Classification of Renewable Energy Sources- Solar, Wind, Geothermal, Biomass, Ocean energy sources, Tidal Energy, MHD generator, Thermionic converter, Thermo electric converter

4 Solar Energy: Energy available from Sun, Solar radiation data,

5 Solar geometry, solar radiation measurements : solar constants, Radiation data, Average solar radiation, radiation on tilted surfaces

6 Solar energy Collectors- Flat plate and Concentrating collectors: Principle of conversion of energy, Flat plate collector, Collector energy balance equation, Thermal Analysis of FPC, Useful heat gain, Focusing collectors, advantages and disadvantages, Factors affecting collector performance

7 Solar thermal devices: Principle of natural drying system, direct type and mixed mode type

8 Solar thermal devices: Forced convection drying system :hybrid dryers , bin type dryers

9 Solar water heating: natural circulation and forced circulation types

10 Space heating: principle of working, types

11 solar still, solar pond: principle of working, types

12 Solar green houses: Introduction, basics of plant growth, greenhouse design

13 Solar greenhouses: Modes of heat transfer, Greenhouse drying

14 Solar Photo voltaics: fundamentals of photovoltaic conversion, semi-conductor materials, photon energy p-n junctions. Light absorption in semi-conductor, solar cell materials

15 Solar cells: silicon solar cells, module design, efficiency of solar cell materials

16 PV systems, Stand alone, Grid connected solar power station

17 Calculation of energy through photovoltaic power generation and cost economics

18 Wind Energy: Energy available from wind, General formula, Lift and drag forces

19 Basis of Wind energy conversion: classification, horizontal and vertical axis machines, design considerations and performance

20 Effect of density, Frequency variances, Angle of attack, Wind speed

21 Types of windmill rotors, Determination of torque coefficient, Induction type generators, Working principle of wind power plant

22 Bio-energy: Pyrolysis of Biomass to produce solid, liquid and gaseous fuels

23 Biomass gasification, advantages, Types of gasifier

24 Biomass cook stoves for rural energy needs

25 Biogas: advantages of aerobic digestion, phases, type of micro organisms

26 Bio gas: classification of bio gas plants, continuous and batch type, drum and dome type

27 Types of biogas plants, janata, deenabanghu, KVIC

28 Comparison between Janatha and KVIC biogas plants

29 Biogas generation, factors affecting biogas generation and usages

30 Design consideration and numericals on biogas plant

31 Design consideration and numericals

32 Advantages and disadvantages of biogas spent slurry

Practical

1 Demonstration of box type solar cooker
2 Demonstration of parabola type solar cooker
3 Demonstration of Solar water heating system
4 Demonstration of Natural convection solar dryer
5 Demonstration of forced convection solar dryer(Cabinet dryer)
6 Demonstration of solar desalination unit
7 Demonstration of solar greenhouse for agriculture production
8 Demonstration of fixed type biogas plant(Janata)
9 Demonstration of floating type biogas plant(KVIC)
10 Demonstration of various biomass gasifiers
11 Demonstration of various biomass gasifiers
12 Demonstration of biomass improved cook-stoves
13 Demonstration of solar photovoltaic system
14 Demonstration of solar photovoltaic system
15 Visit to local wind mill/solar energy park
16 Practical Examination

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REEN 351 Renewable Power Systems 2(1+1)

Course outlines

Theory

Energy consumption pattern & energy resources in India. Renewable energy options, potential and utilization. OTEC- Introduction, Methods of Ocean Thermal Electric Power generation, Open, Closed and Hybrid Cycle system, Heat Exchangers, Site selection, Prospects

of OTEC in India, tidal power: principles and types, MHD-Introduction, Principles of MHD power generation, MHD systems-Open and Closed Cycle Systems, MHD design Problems and developments, Advantages, Materials for MHD generators. Hydrogen and fuel cell technology-Introduction, Electrolysis, Tank type Electrolyzer, Filter press Electrolyzer, Thermo chemical methods, Westinghouse electrochemical thermal sulfur cycle, Ispra mark 13 cycle, Iodine sulpher cycle hydrogen and fuel cell technology. Mini and micro small hydel plants-Nature, classification of small hydro power stations, Components of hydroelectric scheme. Fuel cells and its associated parameters-introduction, Design and principle of operation of Fuel cell. Hydrogen fuel cells, classification of Fuel cells, Types of fuel cells, Advantages and Disadvantages, Conversion efficiency of fuel cell, Polarization in fuel cells, Work output and EMF of fuel cells, Applications.

Practical

Performance evaluation of solar water heater; Performance evaluation of solar cooker; Characteristics of solar photovoltaic panel; evaluation of solar air heater/dryer; Performance evaluation of biomass gasifier engine system (throatless & downdraft), Performance evaluation of a fixed dome type biogas plant; Performance evaluation of floating drum type biogas plant; Estimation of calorific value of biogas & producer gas; Testing of diesel engine operation using dual fuel and gas alone

Objectives

Concepts of utilization of non-conventional energy resources such as gasifiers, biogas, solar, wind, etc. with theoretical background will be taught to effectively utilize the energy for agricultural operations and agricultural processing activities

Lecture

Theory

1 Energy consumption pattern & Energy resources in India
2 Renewable energy options, potential and utilization
3 OTEC-Methods of Ocean Thermal Electric Power generation, Open, Closed and Hybrid Cycle system
4 Heat Exchangers, Site selection, Prospects of OTEC in India
5 Tidal Energy-Principles of tidal power, Types of tidal power plants,
6 Components of tidal power plant, estimation of energy and power in single basin and double basin tidal system
7 MHD- Principles of MHD power generation, MHD systems-Open and Closed Cycle Systems-Advantages
8 MHD design Problems and developments, Advantages, Materials for MHD generators,
9 Hydrogen and fuel cell technology- Electrolysis, Tank type Electrolyzer, Filter press Electrolyzer
10 Thermo chemical methods, Westinghouse electrochemical thermal sulfur cycle, Ispra mark 13 cycle, Iodine sulpher cycle

11 Fossil fuel methods, Solar Energy methods, Hydrogen Storage, utilization of Hydrozen gas, Safety and management

12 Mini and micro small hydel plants-Nature, classification of small hydro power stations, Components of hydroelectric scheme

13 Civil works for mini and micro hydel projects, different type of turbines, Advantages and limitations

14 Fuel cells and its associated parameters-introduction, Design and principle of operation of Fuel cell, Hydrogen fuel cells, classification of Fuel cells

15 Types of fuel cells, Advantages and Disadvantages, Conversion efficiency of fuel cell

16 Polarization in fuel cells, Work output and EMF of fuel cells, Applications.

Practical

1 Study of Open cycle OTEC system

2 Study of Closed cycle OTEC system

3 Study of Hybrid cycle OTEC system

4 Study of Single basin and Double basin tidal energy system

5 Problems on estimation of energy and power in single basin and double basin tidal system

6 Study of MHD- Open and Closed Systems

7 Study of Thermo-chemical cyclic processes of Hydrogen energy

8 Study of Thermo-chemical cyclic processes of Hydrogen energy

9 Study of Bio photolysis system

10 Study of photo electrolysis System

11 Study of Hydel power plant

12 Visit to hydel power plant

13 Study of different types of fuel cells

14 Study of different types of fuel cells

15 Visit to local solar energy park

16 Practical Examination

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REEN 352 Bio-energy Systems: Design and Applications 3(2+1)

Course

Theory

Fermentation processes and its general requirements, An overview of aerobic and anaerobic fermentation processes and their industrial application. Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential. Biomass Production: Wastelands, classification and their use through energy plantation, selection of species, methods of field preparation and transplanting. Harvesting of biomass and coppicing characteristics. Biomass preparation techniques for harnessing (size reduction, densification and drying). Thermo-chemical degradation. History of small gas producer engine system. Chemistry of gasification. Gas producer – type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas. Application, shaft power generation, thermal application and economics. Trans-esterification for biodiesel production. A range of bio-hydrogen production routes. Environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.

Practical

Study of anaerobic fermentation system for industrial application, Study of gasification for industrial process heat, Study of biodiesel production unit, Study of biomass densification technique (briquetting, pelletization, and cubing), Integral bio-energy system for industrial application, Study of bio-energy efficiency in industry and commercial buildings, Study and demonstration of energy efficiency in building, Measuring efficiency of different insulation technique, Study of Brayton, Striling and Rankine cycles, Study of modern green house

Objectives

To study the overview of aerobic and anaerobic fermentation processes and their industrial application, Bio-mass preparation techniques, gasification for industrial process heat, bio-diesel production unit, bio-mass densification technique

Lecture

Theory

1 Fermentation processes and its general requirements
2 An overview of aerobic processes and their industrial application

3 An overview of aerobic fermentation processes
4 Industrial application
5 Heat transfer processes in anaerobic digestion systems
6 Heat transfer processes in anaerobic digestion systems. Land fill gas technology and potential
7 Biomass Production: estimation of biomass resources
8 Biomass Production:logistics
9 Wastelands, classification
10 Wastelands, use through energy plantation, selection of species. Biomass Production: Methods of field preparation and transplanting
11 Harvesting of biomass and coppicing characteristics
12 coppicing characteristics of biomass
13 Biomass preparation techniques for harnessing-size reduction
14 Biomass preparation techniques for harnessing- densification
15 Biomass preparation techniques for harnessing- drying
16 Thermo-chemical degradation
17 History of small gas producer engine system. Chemistry of gasification
18 Gas producer – type, operating principle
19 Gasifier fuels, properties, preparation
20 Preparation of producer gas
21 Conditioning of producer gas
22 Applications of producer gas
23 Shaft power generation from producer gas
24 Thermal application and economics of producer gas
25 Trans-esterification for bio-diesel production
26 Trans-esterification for bio-diesel production
27 A range of bio-hydrogen production routes
28 A range of bio-hydrogen production routes
29 Environmental aspect of bio-energy
30 Environmental aspect of bio-energy
31 Assessment of greenhouse gas mitigation potential
32 Assessment of greenhouse gas mitigation potential

Practical

1 Study of anaerobic fermentation system for industrial application
2 Study of gasification for industrial process heat
3 Study of bio-diesel production unit
4 Study of bio-diesel production unit

5 Study of bio-mass densification technique -briquetting
6 Study of bio-mass densification technique- pelletization, and cubing
7 Integral bio-energy system for industrial application
8 Study of bio-energy efficiency in industry and commercial buildings
9 Study and demonstration of energy efficiency in building, Measuring efficiency of different insulation technique
10 Study of Brayton cycle
11 Study of Striling cycle
12 Study of Rankine cycle
13 Study of modern greenhouse technologies
14 Study of modern greenhouse technologies
15 Visit to local biogas plats/ industries using biogas or producer gas
16 Practical Examination

References

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3. Centre for biomass energy. 1998. Straw for energy production; Technology- Environment-Ecology. Available: www.ens.dk.
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5. Perspectives of Feedstock Supply for Biomass-Based Energy Plant Development in India: Views from an Expert Survey. www.mdpi.com/2078-1547/6/1/71/pdf.
6. The Asian Biomass hand book. The Japan Institute of Energy. http://www.jie.or.jp/biomass/AsiaBiomassHandbook/English/All_E-080917.pdf
7. Rathore NS, Mathur, AN, Kothari. 2007. Alternate Sources of Energy. ICAR, New Delhi.

Department of Basic Engineering

AEBE 161 Surveying and Levelling 3(1+2)

Course outlines

Theory

Surveying: Introduction, classification and basic principles, Linear measurements. Chain surveying. Cross staff survey, Compass survey. Plani-meter, Errors in measurements, their elimination and correction. Plane table surveying. Levelling, Leveling difficulties and error in leveling, Contouring, Computation of area and volume. Theodolite traversing. Introduction to setting of curves. Total station, Electronic Theodolite. Introduction to GPS survey.

Practical

Chain survey of an area and preparation of map; Compass survey of an area and plotting of compass survey; Plane table surveying; Levelling. L section and X sections and its plotting; Contour survey of an area and preparation of contour map; Introduction of software in drawing contour; Theodolite surveying; Ranging by Theodolite, Height of object by using Theodolite; Setting out curves by Theodolite; Minor instruments. Use of total station.

Objectives

To enable the students to acquire skills in the measurement of land, preparation of plans and maps and find out their areas (regular or irregular) either for civil engineering or Agricultural Engineering related works, in general, and land and water management works in particular by various methods and instruments(chains, tapes, compasses plane table etc.) available commercially. Further to enable the students to take and calculate the reduced levels with the help of various leveling instruments and prepare contour maps. Also to enable the students thorough with Theodolite traversing, Electronic Theodolite, GPS survey.

Lecture

Theory

1 Introduction of Surveying, definition, units of measurement - basic units of length, area and volume, objectives of surveying, classification of surveying

2 Uses of surveys and Principles of surveying- Difference between a plan and map, precision in surveying- work of the surveyor. Measurement of distance - Linear Measurements, direct measurement, chains and their constructional details, chain types

3 Measuring tapes-Instruments for chain survey. Instruments for marking stations, instruments used for ranging. direct ranging, indirect ranging, reciprocal ranging, folding and unfolding of chain

4 Method of chaining- Errors in measurements - Chain and tape corrections - problems on correction of distance and areas

5 Chain surveying-Triangulation-basic definitions-Base line, check line and tie line- field work in chain surveying-Method of booking field notes-offsets-layout of offsets

6 Cross Staff survey-types of cross staffs-French cross staff, Optical square etc.- computation of areas by plani-meter

7 Compass Survey-Introduction-types of traversing –Meridians-True meridian, Magnetic Meridian, Arbitrary Meridian. Description of prismatic and Surveyor's compass-method of declination – concept of local attraction

8 Bearings-types- designation of bearings –fore and back bearings, Examples on bearings-Included angles-Examples on computation of Included angles. Determination of true bearings from magnetic bearings

9 Plane table survey-basic definitions-setting of plane table-orientation-methods of plane tabling

10 Levelling-introduction-basic definitions-Methods of leveling. Classification of leveling-profile leveling-cross sectioning-curvature and refraction leveling-Instruments used in leveling - Levelling difficulties and errors in leveling

11 Temporary adjustments of dumpy level, Bench Marks-Booking the staff readings-Methods of calculating reduced level-Height of collimation and Rise and Fall methods

12 Contouring – characteristics of contour lines-contour drawing - Computation of area and volume

13 Theodolite traversing – components of the theodolite – types - temporary adjustments in Theodolite

14 Introduction to setting of curves- horizontal curves- vertical curves- need for providing curves- classification of curves- degree of circular curve – stationing - layout of a curve by the incremental chord method- layout of a curve by the total chord method

15 Total station- Operations of Total Station – use of total station – advantages, Electronic Theodolite difference between total station and Theodolite

16 Introduction to GPS survey- The Fundamental Components of GPS – errors in GPS

Practical

1 Measurement of distances by pacing method

2 Acquaintance with the survey instruments

3 Folding, unfolding of the chain and ranging a chain line

4 Chain triangulation survey

5 Plotting of chain triangulation

6 Cross staff survey

7 Plotting of cross staff survey

8 Study of prismatic compass and surveyor compass and accessories

9 Compass survey by intersection method and plotting

10 Plotting of compass survey by intersection method

11 Compass survey by traverse method and plotting

12 A tutorial class on problems on bearings

13 Plane table survey by radiation and plotting

14 Acquaintance with leveling equipment

15 Temporary adjustments for a leveling instrument

16 Tutorial class on reduction of levels

17 Simple leveling

18 Profile leveling

19 Differential leveling

20 Contour survey by grid method

21 Plotting of contour map

22 Computation of areas and volumes

23 Introduction of software in drawing contour

24 Study of Theodolite and temporary adjustments

25 Measurement of horizontal angles by repetition method

26 Measurement of horizontal angles by reiteration method

27 Measurement of vertical angles/ Height of object and deflection angles

28 Traversing by included angles

29 Setting out curves by Theodolite

30 Detailed study of components total station

31 Total station survey of an area

32 Practical Examination

References

1. Kanetkar T. P. 1993. Surveying and Levelling. Pune Vidyarthi Griha, Prakashan, Pune.
2. Arora K. R. 1990. Surveying (Vol.I), Standard Book House, Delhi.
3. Punmia B. C. 1987. Surveying (Vol.II). Laxmi Publications, New Delhi.
4. Venugopala Rao P. 2015. Text book of Surveying, PHI Learning pvt (Ltd), Delhi
5. Satheesh Gopi 2008. Advanced Surveying (Total station, GIS and Remote sensing), Dorling Kindersely (India) Pvt. Ltd, Delhi.

AEBE 162 Engineering Mechanics 3 (2+1)

Course outlines

Theory

Basic concepts of Engineering Mechanics. Force systems, Centroid, Moment of inertia, Free body diagram and equilibrium of forces. Frictional forces Analysis of simple framed structures using methods of joints, methods of sections and graphical method. Simple stresses. Shear force and bending moment diagrams. Stresses in beams. Torsion. Analysis of plane and complex stresses.

Practical

Problems on composition and resolution of forces, moments of a force, couples, transmission of a couple, resolution of a force into a force & a couple; Problems relating to resultant of; Co-planer force system, collinear force system, concurrent force system, co-planer concurrent force system, co-planer non-concurrent force system, Non-coplaner concurrent force system, Non-coplaner & non-concurrent force system, system of couples in space; Problems relating to centroids of composite areas; Problems on moment of inertia, polar moment of inertia, radius of gyration, polar radius of gyration of composite areas; Equilibrium of concurrent – co-planer and non-concurrent & co-planer force systems; Problems involving frictional forces; Analysis of simple trusses by method of joints and method of sections; Analysis of simple trusses by graphical method; Problems relating to simple stresses and strains; Problems on shear force and bending moment diagrams; Problems relating to stresses in beams; Problems on torsion of shafts; Analysis of plane and complex stresses.

Objectives

To impart knowledge and training to students on the basic principles of physical and engineering mechanics of solid systems involving forces, moments, stresses and shear forces for applications in designs of engineering structures

Lecture

Theory

1 Introduction, Divisions of Engineering Mechanics and Basic Units
2 System of Forces, Resultant for Composition of forces
3 Analytical method for resultant force, Parallelogram law of forces
4 Method of resolution for the resultant force
5 Moment of a force, Types of moments and law of moments
6 Levers, types of levers, simple and compound levers
7 Classification of parallel forces, analytical method for the resultant of parallel forces
8 Couple, moment of a couple, classification of couples
9 Couple, moment of a couple, classification of couples

10 Equilibrium of forces, analytical method for the equilibrium of coplanar forces, Conditions and types of equilibrium

11 Equilibrium of forces, analytical method for the equilibrium of coplanar forces, Conditions and types of equilibrium

12 Centre of gravity, centroid, methods for centre of gravity

13 Moment of inertia, moment of inertia of an area of plane figure w.r.t an axis in it plane

14 Moment of inertia, moment of inertia of an area of plane figure w.r.t an axis in it plane

15 Determination of moment of inertia of simple geometrical sections

16 Determination of moment of inertia of simple geometrical sections

17 Frictional forces, types, limits and laws of friction

18 Frictional forces, types, limits and laws of friction

19 Angle of friction, coefficient of friction

20 Types of loading, methods for the reactions of a beam, analytical and graphical methods

21 Types of loading, methods for the reactions of a beam, analytical and graphical methods

22 Types of loading, methods for the reactions of a beam, analytical and graphical methods

23 Simple stresses, drawing of shear force and bending moment diagrams for different types of beams under different loading conditions

24 Simple stresses, drawing of shear force and bending moment diagrams for different types of beams under different loading conditions

25 Simple stresses, drawing of shear force and bending moment diagrams for different types of beams under different loading conditions

26 Types of frames, simple stresses

27 Analysis of simple framed structures using method of joints

28 Analysis of simple framed structures using method of sections

29 Analysis of simple framed structures using graphical method

30 Analysis of plane and complex stresses

31 Types of shafts and torque and strength relations in stationary and motion

32 Types of shafts and torque and strength relations in stationary and motion

Practical

1 Problems on resultant forces

2 Problems on graphical method for resultant forces

3 Problems on moment of forces

4 Problems on simple and compound levers

5 Problems on simple and compound levers

6 Graphical method for the resultant of parallel forces

7 Problems on couples

8 Problems on equilibrium of forces

9 Problems on centre of gravity of plane, symmetrical and un symmetrical sections

10 Problems on centre of gravity of plane, symmetrical and un symmetrical sections

11 Problems on moment of inertia , polar moment of inertia and radius of gyration

12 Problems on frictional forces

13 Problems on simple trusses by method of joints, sections and graphical methods

14 Problems related to stress in beams

15 Problems on torsion of shafts

16 Practical Examination

References

1. Khurmi, R . S. 2007. A Text Book of Engineering Mechanics, S. Chand & Company Limited, New Delhi.
2. Timoshenko S and Young D. H. 2003. Engineering Mechanics, Mc Graw Hill Book., New Delhi
3. Bansal R. K. 2005. A Text Book of Engineering Mechanics, Lakshmi Publishers, New Delhi.
4. Khurmi R. S. and Gupta J K 2005. A Text Book of Machine Design, Chand & Company Limited, New Delhi.
5. Kumar, K. L 1998. Engineering Mechanics, Tata McGraw-Hill Publishing Company Limited, New Delhi

AEBE 163 Engineering Drawing 2 (0+2)

Course outlines

Practical

Introduction of drawing scales; First and third angle methods of projection. Principles of orthographic projections; References planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain 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. Different methods of dimensioning. Concept of sectioning. Revolved and oblique sections. 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. Nomenclature, thread profiles, multi start threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts. Forms of screw threads, representation of threads, Bolts- headed centre, stud screws, set screws, butt, hexagonal and square; keys-types, taper, rank taper, hollow saddle etc.

Objectives

To equip the students with knowledge and skills on visualization of buildings, objects, equipment, machines through drawings, plans, sectional views, isometric views and orthographic projections. To impart knowledge and skills to the students in computer aided designs involving graphics and machine drawing

Lecture

Practical

1. Introduction of drawing instruments & their uses, lettering
2. Introduction to drawing scales – plain scale & diagonal scales, Methods of projection – orthographic projection and orthographic projection, First and third angle projections.
3. Projections of points and lines in space, Traces of line and planes
4. Projections of points on an auxiliary plane, Projections of lines and planes by the use of auxiliary planes, Determining the true length of a line and true shape of a plane figure
5. Projections of planes – Types of planes, Projections of oblique planes with examples
6. Projections of solids – types of solids, projections of solids in simple positions
7. Projections of solids – axis inclined to one of the reference planes and parallel to the other, axis inclined to V.P and parallel to the H.P, axis inclined to H.P and parallel to the V.P, axis inclined to both H.P and V.P
8. Sections of solids – Drawing of sections of planes of Prism, Pyramid and Cylinder.
9. Sections of solids – Drawing of sections of planes of Prism, Pyramid and Cylinder.
10 Development of surfaces – methods of development, development of cube, cylinder
11 Development of pyramid and cone
12. Intersection of two prisms, intersection of two cylinders
13. Intersection of cylinder & prism, intersection of cone and cylinder
14. Dimensioning methods and principles of dimensioning, development of missing views
15. Orthographic projections – preparation of manual drawings with dimensions from models, simple machine parts
16. Orthographic projections – preparation of manual drawings with dimensions from models, machine components
17. Orthographic projections – piston, connecting rod

18. Orthographic projections – preparation of manual drawings with dimensions from models, simple machine parts
19. Isometric projections – isometric drawings of objects and machine components
20. Isometric projections – isometric drawings of objects and machine components
21. Isometric projections – isometric drawings of objects and machine components
22. Isometric projections – isometric drawings of objects and machine components
23. Isometric projections – screw jack, knuckle joint, stuffing box and cotter joint
24. Sectional drawing of simple machine parts
25. Sectional drawing of foot step bearing, shaft support and stuffing box
26. Drawing of riveted joints, representation of different types of welded joints
27. Screw threads – introduction, terms related to screw thread, forms of screw threads, representation of threads, multiple start threads, right hand and left hand threads
28. Thread fasteners – drawing of square and hexagonal headed bolts and square and hexagonal bolts
29. Drawing of lock nuts, studs, and machine screws
30. Drawing of cap screws, wood screws and foundation bolts
31. Drawing of keys, taper, rank taper, hollow saddle etc.
32. Practical Examination

References

1. Bhat N. D. 2010. Elementary Engineering Drawing. Charotar Publishing House Pvt. Ltd., Anand.
2. Bhatt N. D. and Panchal V. M. 2013. Machine Drawing. Charotar Publishing House Pvt. Ltd., Anand.
3. Narayana K. L. and Kannaiah P. 2010. Machine Drawing. Scitech Publications (India) Pvt. Ltd., Chennai.

AEBE 164 Fluid Mechanics and Open Channel Hydraulics 3 (2+1)

Course outlines

Theory

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, meta-centre and meta-centric height, condition of floatation and stability of submerged and floating bodies; 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, venture-meter, orifice meter and nozzle, siphon; Laminar flow: Stress strain relationships, flow between infinite parallel plates both plates fixed, one plate moving, discharge, average velocity; Laminar and turbulent flow in pipes, general equation for head loss Darcy, Equation, Moody's diagram, 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, 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, dimensionless numbers. Introduction to fluid machinery.

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; Measurement of force exerted by water jets on flat and hemispherical vanes; Determination of meta-centric height; Determination of efficiency of hydraulic ram; Performance evaluation of Pelton and Francis turbine; Study of current meter; Velocity distribution in open channels and determination of Manning's coefficient of rugosity.

Objectives

To enable the students to design efficient water conveyance systems like canals, channels and pipes from places of origin to delivery points by acquiring knowledge on the principles of mechanics of fluids, water measurement, regulation and open channel hydraulic principles. The course enhances the design and planning capacity of students in management of irrigation flow.

Lecture

Theory

1 Fluids-definitions-classification-properties, dimensions

2 Fluid pressure-Introduction-Measurement of fluid pressure-piezometer tube-manometer-types of manometers

3 Mechanical gauges-Bourdon's tube pressure guage-Diaphragm pressure guage-Dead weight pressure guage

4 Fluid Static force on submerged surfaces –Total force on horizontal, vertical and inclined surfaces

5 Center of pressure of an inclined immersed surface-Centre of pressure of a composite section

6 Pressure on a curved surface and its applications

7 Buoyancy, meta-centre and meta-centric height, condition of floatation and stability of submerged and floating bodies

8 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;

9 Dynamics of fluid flow-Various forms of energy in flow, frictional loss, general equation

10 Bernoulli's theorem, Euler's equation of motion

11 Practical applications of Bernoulli's theorem, Venturi-meter, Pitot tube, Orifice meter, nozzle, siphon

12 Laminar flow: Stress strain relationships, flow between infinite parallel plates both plates fixed, one plate moving, discharge, average velocity

13 Laminar and turbulent flow in pipes, general equation for head loss, Darcy Equation, Moody's diagram, Minor and major hydraulic losses through pipes and fittings, flow through network of pipes, hydraulic gradient and energy gradient

14 Flow through orifices (Measurement of Discharge)-Types of orifices, Jet of water, vena contracta, Hydraulic coefficients, Experimental Method for Hydraulic Coefficients, Discharge through a rectangular orifice

15 Flow through Orifices (Measurement of Time)-Time of Emptying a square, rectangular or circular tank through an orifice at its bottom, Time of emptying a Hemispherical tank through an orifice at its bottom

16 Time of emptying a circular horiztontal tank through an orifice at its bottom. Time of emptying a tank of variable cross-section through an orifice

17 Flow through Mouthpieces-Types of Mouthpieces-Loss of Head of a liquid flowing in a pipe, Discharge through a Mouthpiece

18 Flow over Notches-Types of Notches, Discharge over a Rectangular Notch, Triangular Notch, Stepped Notch. Time of emptying a tank over a Rectangular Notch, Triangular Notch

19 Flow over weirs-Types of weirs, Discharge over a weir, Francis's formula for Discharge over a Rectangular weir (Effect of End Contractions), Bazin's formula for discharge over a rectangular weir, velocity of approach, Determination of Velocity of Approach

20 Flow through simple pipes-Loss of head in pipes, Darcy's formula for loss of Head in pipes, Chezy's formula for loss of head in pipes

21 Time of Emptying a tank through a long pipe, Time of flow from one tank into another through a long pipe

22 Flow through compound pipes-Discharge through a compound pipe (Pipes in series) Discharge through pipes in parallel, Equivalent size of a pipe, Discharge through branched pipes from one reservoir to another

23 Open channel hydraulics-classification of open channel and definitions

24 Chezy's formula for discharge through an open channel

25 Bazin's formula and Kutter's formula for discharge, Problems on design

26 Manning's formula for discharge through an open channel

27 Specific energy concept-Specific energy of a flowing fluid, specific energy diagram, critical depth, Types of flows, critical velocity

28 Velocity and Pressure profiles in open channels

29 Hydraulic jump, Types of Hydraulic Jumps, Depth of Hydraulic Jump, Loss of Head due to Hydraulic Jump

30 Dimensional analysis and similitude-Rayleigh's method

31 Buckingham's pi theorem

32 Types of similarities, dimensionless numbers, Introduction to fluid machinery

Practical

1 Study of Manometers and pressure gauges

2 Determination of meta-centric height

3 Verification of Bernoulli's theorem

4 Measurement of discharge with a venture-meter

5 Measurement of velocity with a pitot tube

6 Determination of coefficient of discharge of rectangular notch

7 Determination of coefficient of discharge of triangular notch

8 Determination of hydraulic coefficient of orifices

9 Determination of hydraulic coefficient of mouthpieces

10 Experiment on broad crested weir

11 Determination of head losses in pipes

12 Study of fluid machinery: hydraulic ram, Pelton and Francis turbine

13 Determination of roughness coefficients of open channels

14 Measurement of velocity and pressure profiles in open channels

15 Problems on construction of flow net

16 Practical Examination

References

1. Khurmi, R .S. 1970. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines S. Chand & Company Limited, New Delhi.

2. Modi P. M. and Seth S.M.1973. Hydraulics and Fluid Mechanics. Standard Book House, Delhi.

3. Chow V. T. 1983. Open Channel Hydraulics. McGraw Hill Book Co., New Delhi.

4. Banasal R. K. 2011. A text book of Fluid Mechanics and Hydraulic Machines, Laxmi publications(p) Ltd., New Delhi.

AEBE 165 Strength of Materials 2 (1+1)

Course outlines

Theory

Slope and deflection of beams using integration techniques, moment area theorems and conjugate beam method. Columns and Struts. Riveted and welded connections. Stability of masonry dams. 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 metal specimen (M.S., C.I.), 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, C.I., M.S. & Wood specimens and to determine various physical and mechanical properties; To perform the bending test on the specimens; M.S. Girder, Wooden beam, Plain concrete beams & R.C.C. beam, and to determine the various physical and mechanical properties; To determine Young's modulus of elasticity of beam with the help of deflection produced at centre due to loads placed at centre & quarter points; To study the behaviour of materials (G.I. pipes, M.S., C.I.) under torsion and to evaluate various elastic constants; To study load deflection and other physical properties of closely coiled helical spring in tension and compression; To perform the Rockwell, Vicker's and Brinell's Hardness tests on the given specimens; To perform the Drop Hammer Test, Izod Test and Charpay's impact tests on the given specimens; To determine compressive & tensile strength of cement after making cubes and briquettes; To measure workability of concrete (slump test, compaction factor test); To determine voids ratio & bulk density of cement, fine aggregates and coarse aggregates; To determine fatigue strength of a given specimen; To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials.

Objectives

The students learn about the advanced aspects of engineering mechanics like tensile stress, compressive stresses, shear forces, bending moments in beams, columns, slabs, welded joints and trusses of engineering structures for applications in the designs of the structures

Lecture

Theory

1 Introduction – Stresses, Tensile, Compressive and Shear- Strains, Units- Elastic Curve- Elastic Limit – Poisons Ratio. Elastic Constants- Young's Modulus (E), Bulk Modulus (K) and Shear Modulus (G) – Relation between them

2 Stresses in uniformly tapered circular sections- Stresses in bars of composite sections. Thermal Stresses and Strains in simple bars and composite bars

3 Methods of finding out slopes & deflections of beams, Double integration method.

4 Slope and Deflection equations of a simply supported beam with a central point load, simply supported beam with eccentric point load

5 Simply supported beam with a uniformly distributed load

6 Columns and struts, Euler's column theory. Assumptions of Euler's column theory, Buckling load- derivations for buckling load of a column with one end fixed other free, with one end fixed and other hinged

7 Expression for buckling load of a column with both ends hinged- with both ends fixed. Types of end conditions of columns; both ends hinged, both ends fixed, one end fixed and other is hinged & one end fixed and other end is free.

8 Types of end conditions of columns; both ends hinged, both ends fixed, one end fixed and other is hinged & one end fixed and other end is free. Limitations of Euler's formula- Rankine's formula for columns

9 Riveted joints, types of joints- Design of riveted joints, eccentric riveted connections, strength of a rivet and riveted joint-efficiency of a riveted joint.

10 Welded joints, types of welded joints- Strength of welded joints, technical terms.

11 Design of welded joints, eccentric welded joints.

12 Propped cantilever and beams – Fixed and continuous beams-Deflection and Slope equations

13 Dams, forces acting, stressed at the base width of dams

14 Stability of dams, design of base width of dams

15 Super position theorem- Claypeyron's theorem of three moments. Application of Clayperon's theorem of three moments.

16 Moment distribution methods- Analysis of statistically indeterminate beams

Practical

1 To perform the tension test on metal specimen M.S to observe stress – strain behavior, modulus of elasticity (E), ultimate stress, permissible stress, per cent elongation etc., and to study its fracture

2 To perform the tension test on metal specimen C.I. to observe stress – strain behavior, modulus of elasticity (E), ultimate stress, permissible stress, persent elongation etc., and to study its fracture

3 To perform compression test on concrete cylinders and cubes

4 To perform compression test on CI, MS & wood material

5 To perform the bending test on the specimens M.S & Wooden beam

6 To perform the bending test on the specimens Plain concrete & R.C.C. beams

7 To determine Young's modules E of beams with the help of deflection produced at centre due to loads placed at centre

8 To determine Young's modules 'E' of beams with the help of deflection produced at centre due to loads placed at quarter point

9 To study the behavior of materials (G.I. pipes, MS, CI) under torsion and to evaluate various elastic constants

10 To study load deflection and other properties of closely coiled helical spring in tension and compression

11 To perform the Rockwell, Vicker and Brinell's Hardness tests on the given specimens

12 To perform the drop hammer test, Izod Test &Charpay's impact tests on the given specimens.

13 To determine the fatigue strength of a given specimen

14 To determine compressive & tensile strength of cement after making cubes and briquettes

15 To write detail report emphasizing engineering importance of performing tension, compression, bending, torsion, impact and hardness tests on the materials

16 Practical Examination

References

1. Khurmi R. S. 2001. Strength of Materials, S. Chand & Co., Ltd., New Delhi.

2. Junarkar S. B. 2001. Mechanics of Structures (Vo-I), Choratar Publishing House, Anand.

3. Ramamrutham S. 2003. Strengths of Materials, Dhanpat Rai and Sons, NaiSarak, New Delhi.

AEBE 166 Workshop Technology and Practices 3 (1+2)

Course outlines

Theory

Introduction to various carpentry tools, materials, types of wood and their characteristics and Processes or operations in wood working; Introduction to Smithy tools and operations; Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding

techniques and equipment. Principle of arc welding, equipment and tools. Casting processes; Classification, constructional details of center lathe, Main accessories and attachments. Main operations and tools used on center lathes. Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations. Types of drilling machines. Constructional details of pillar types and radial drilling machines. Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine.

Practical

Preparation of simple joints: Cross half Lap joint and T-Halving joint; Preparation of Dovetail joint, Mortise and tenor joint; Jobs on Bending, shaping etc.; Jobs on Drawing, Punching, Rivetting. Introduction to tools and measuring instruments for fitting; Jobs on sawing, filing and right angle fitting of MS Flat; Practical in more complex fitting job; Operations of drilling,, reaming, and threading with tap and dies; Introduction to tools and operations in sheet metal work; Making different types of sheet metal joints using G.I. sheets. Introduction to welding equipment, processes tools, their use and precautions; Jobs on ARC welding – Lap joint, butt joint; T-Joint and corner joint in Arc welding; Gas welding Practice – Lab, butt and T-Joints; Introduction to metal casting equipment, tools and their use; Mould making using one-piece pattern and two pieces pattern; Demonstration of mould making using sweep pattern, and match plate patterns; Introduction to machine shop machines and tools; Demonstration on Processes in machining and use of measuring instruments; Practical jobs on simple turning, step turning; Practical job on taper turning, drilling and threading; Operations on shaper and planer, changing a round MS rod into square section on a shaper; Demonstration of important operations on a milling machine, making a plot, gear tooth forming and indexing; Any additional job.

Objectives

To impart knowledge and skills to students in manufacturing processes of machines, tools and equipment and hands-on training on various aspects of machine shop for encouraging entrepreneur development for engineering enterprises in general and farm mechanization in particular.

Lecture

Theory

1 Introduction to various carpentry tools; Marking & measuring tools

2 Planning, boring and striking tools

3 Wood working processes, types of wood and their characteristics

4 Introduction to smithy and forging tools and operations

5 Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames and welding techniques and equipments

6 Principles of arc welding, equipment and tools

7 Introduction to molding and Casting processes

8 Classification, constructional details of center lathe

9 Main accessories and attachments of center lathe

10 Main operations and tools used on center lathe

11 Types of shapers, construction details of standard shaper

12 Work holding devices, tools and main operations of shapers

13 Types of drilling machines, construction details of pillar type and radial type drilling machines

14 Main operations of drilling machines, twist drills, drill angles and sizes

15 Types and classifications of milling machines, construction details and principles of operation of column and knee type universal milling machines

16 Plain milling cutters, and operations on milling machine

Practical

1 Preparation of simple wooden joints - Cross half lap joint

2 Preparation of simple wooden joints - T-halving joint

3 Preparation of simple wooden joints - Dovetail joint

4 Preparation of simple wooden joints - Mortise and tenor Joint

5 Jobs on bending, shaping, punching, etc.,

6 Jobs on sawing, filing and right angle fitting of MS flat

7 Jobs on sawing, filing and right angle fitting of MS flat

8 Operations of drilling and reaming

9 Operations of drilling and reaming

10 Operations of threading with tap and dies

11 Making different types of sheet metal joints using G.I. sheets

12 Making different types of sheet metal joints using G.I. sheets

13 Jobs on arc welding - Lap joint and butt Joint

14 Jobs on arc welding - T-joint and corner Joint

15 Jobs on gas (oxyacetylene) welding - Lap joint and butt Joint

16 Jobs on gas (oxyacetylene) welding - T-joint

17 Introduction to metal casting equipment, tools and their use

18 Mould making using one-piece pattern

19 Mould making using one-piece pattern

20 Mould making using Two-piece pattern

21 Mould making using Two-piece pattern

22 Demonstration of mould making using sweep pattern and match plate pattern

23 Demonstration of mould making using sweep pattern and match plate pattern

24 Demonstration of measuring instruments in machining processes

25 Practical jobs in plane turning on lathe machine

26 Practical jobs in step turning on lathe machine

27 Practical jobs in taper turning on lathe machine

28 Practical jobs in drilling and threading on lathe machine

29 Practical jobs in drilling and threading on lathe machine

30 Practical jobs on shaper

31 Demonstration of important operations on a milling machine plot, gear teeth, etc

32 Practical Examination

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2. Chapman W. A. J. 1989. Workshop Technology (Part I and II). Arnold Publishers (India) Pvt. Ltd., New Delhi.
3. Raghuwamsi B. S. 1996. A Course in Workshop Technology (Vol. I and II). Dhanpat Rai and Sons, New Delhi.

AEBE 167 Applied Electronics and Instrumentation 3 (2+1)

Course outlines

Theory

Semiconductors. p-n junction. V-I characteristics of p-n junction. diode as a circuit element. rectifier, clipper, damper, voltage multiplier, capacitive filter. diode circuits for OR & AND (both positive and negative logic), bipolar junction transistor: operating point. classification (A, B & C) of amplifier. various biasing methods (fixed. self potential divider). h-parameter model of a transistor. analysis of small signal. CE amplifier. phase shift oscillator, analysis of differential amplifier using transistor. ideal OP-AMP characteristics. linear and non-linear applications of OP-AMP (adder, substractor, integrator, active rectifier. comparator. differentiator. differential, instrumentation amplifier and oscillator). zener diode voltage regulator. transistor series regulator. current limiting. OP-AMP voltage regulators. Basic theorem of Boolean algebra. Combinational logic circuits(basic gates. SOP rule and Kmap). binary ladder D/A converter, successive approximation A/D converter, generalized instrumentation, measurement of displacement.

temperature. velocity, force and pressure using potentiometer, resistance thenno-meter. thermocouples. Bourclen tube. LVDT. strain gauge and tacho-generator.

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.

Objectives

To impart knowledge on applied electronics to students to design and develop automated controls to operate agricultural engineering gadgets and instrumentation for various engineering measurements and operations.

Lecture

Theory

1 Semiconductors, Pn Junction, V-I Characteristics of P-n Junction

2 Efficiency and ripple factor of half wave rectifier (derivation)

3 Efficiency and ripple factor of full wave rectifier (derivation) related problems

4 Clipping circuits, Positive clipper, biased clipper, combination clipper

5 Clamping circuits, positive clamper, negative clamper

6 Diode circuits for OR and AND gates. With truth table

7 Bipolar junction transistor operating point, PNP transistor NPN transistor

8 Transistor as an CE amplifier, load line analysis, current gain, voltage gain, power gain

9 Transistor - Common base connection, expression for collector current and characteristics

10 Common Emitter connection, relation between ß and a and characteristics

11 Common collector connection, relation between ß and a collector current

12 Classification of amplifiers, class A, class B, class C amplifiers

13 Various Biasing methods stability factor, thermal run way, base resistor method

14 Biasing with feedback resistor voltage divider bias

15 Fitter circuits- Series induction filter, ripple factor, regulation output voltage

16 Shunt capacitor filter, ripple factor and regulation

17 Pi filter, voltage multiplier

18 Coupling of amplifiers Gain, Frequency response, Decibel gain, Band width - R-C coupled amplifier, operation, advantages, disadvantages

19 Transformer coupled amplifier, direct coupled amplifier operation, advantages disadvantages and applications

20 Hybrid-Parameters, hybrid equivalent circuit of common emitter amplifier

21 Hybrid parameter of a transistor

22 Oscillators Principle, phase shift oscillator, frequency and condition of maintenance of oscillations, Draw backs

23 Operational Amplifier – Characteristics of an ideal OP-AMP, operational amplifier stages, Equivalent circuit of OP-AMP

24 OP-AMP as integrator, OP-AMP as comparator, and Active rectifiers

25 OP-AMP as differentiator , differential amplifier, adder

26 Regulated d.c. power supply, voltage regulation, minimum load resistance, zener diode voltage regulator

27 Transistor series, voltage regulator

28 OP-AMP as voltage regulator

29 Basic theorem of Boolean Algebra - OR laws, AND laws, NOT laws, commutative law, Associative law distributive laws Absorptive laws

30 Sum of products form (SOP), Karnaugh – Map (K-map), Binary ladder (D/A) converter

31 Instrumentation - Measurement of displacement temperature, force and pressure using potential meter, Measurement velocity. Thermocouples, - Thomson effect, Peltier effect, see-beck effect, Resistance Thermometer

32 Bourdon tube, LVDT (Linior variable differential transformer), strain gauge, AC and DC tacho-generator

Practical

1 To study V-I characteristics of p-n junction diode

2 To study half wave and full wave rectifiers

3 To study 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 a clipper and clamper

8 To study a OP-AMP IC 741 as inverting and non-inverting amplifier

9 To study a OP-AMP IC 741 as differentiator and integrator

10 To study a differential amplifier using two transistor

11 To study a OP-AMP IC 741 as differential amplifier

12 To study a zener regulator circuit

13 To study a OP-AMP IC 741 as a active rectifier

14 To study a OP-AMP IC 741 as a comparator

15 To familiarize with various types of transducers

16 Practical Examinations

References

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2. Shancy A. K. Measurement of Electronics and Electronic Instrumentation. Khanna Publications, New Delhi.
3. Roy Chowdary, Integrated Electronics. John Wiley International, USA
4. Kumar Anand. 2014. Digital Electronics. A. PHI, New Delhi.
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6. Rajendra Prasad, Electronic Measurements and Instrumentation by Khanna Publications, New Delhi.

AEBE 168 Computer Programming and Data Structures 3 (1+2)

Course outlines

Theory

Introduction to high level languages, Primary data types and user defined data types, Variables, typecasting, Operators, Building and evaluating expressions, Standard library functions, Managing input and output, Decision making, Branching, Looping, Arrays, User defined functions, passing arguments and returning values, recursion, scope and visibility of a variable, String functions, Structures and union, Pointers, Stacks, Push/Pop operations, Queues, Insertion and deletion operations, Linked lists.

Practical

Familiarizing with Turbo 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.

Objectives

This course is designed to provide a comprehensive study of the 'C' programming language. It stresses the strengths of 'C', which provide students with the means of writing efficient, maintainable, and portable code. The nature of 'C' language is emphasized in the wide variety of examples and applications. To learn and acquire art of computer programming. To know about some popular programming languages and how to choose programming language for solving a problem. Data structure is a specific method of storing and organizing system data in order to use it efficiently. Large amounts of data including internet indexing services and large databases can be efficiently managed with the implementation of data structures. It also has a major role to play in designing efficient algorithms and system software programs.

Lecture

Theory

1 Introduction to programming languages & its types

2 Introduction to 'C'

3 Steps in learning 'C' – Character set, Identifiers, Keywords, Data types

4 Steps in learning 'C' – Constants, Variables, Escape sequences, Typecasting

5 Steps in learning 'C' – Header Files, Operators, Expressions, Standard Library

6 Steps in learning 'C' – Header Files, Operators, Expressions, Standard Library Functions-Input & Output Functions: (Formatted I/O functions and Unformatted I/O functions)

7 Decision Making/Control Statements, Branching

8 Concept of Looping/ loop statements, Scope and Visibility of variables

9 Concept of Functions – Defining a function & Function Prototypes

10 Types of Functions – Library functions & User defined functions, Parameter Passing Mechanisms, Recursion

11 Concept of Arrays & Its types

12 Concept of a String Library Functions

13 Concept of Pointers, Structures, Unions

14 Introduction to a Data Structures & Its types

15 Concept of a Linked Lists & Its operations

16 Concept of Stacks & Its Operations (PUSH & POP Operations) Concept of queues & Its types and Operations (ENQUEUE & DEQUEUE Operations)

Practical

1 Introduction to a 'C' complier & Its purpose to execute 'C' programs.

2 Building an executable version of a 'C' program – (Basic Structure of 'C' program)

3 To know the purpose of debugging a 'C' program – (Step by step execution of 'C' program)

4 Developing and executing 'C' programs – (Ex: Arithmetic operations on numbers)

5 Developing and executing 'C' programs – (To perform mathematical & logical operations)

6 Developing and executing 'C' programs – (By using conditional operator)

7 Developing and executing 'C' programs – (By using Decision Making/ Control statements: if, if-else)

8 Developing and executing 'C' programs – (By using Decision Making/ Control statements: multiple if-else)

9 Developing and executing 'C' programs – (By using Decision Making/ Control statements: nested if-else)

10 Developing and executing 'C' programs – (By using Decision Making/ Control statements: switch)

11 Developing and executing 'C' programs – (By using Decision Making/ Control statements: break)

12 Developing and executing 'C' programs – (By using Decision Making/ Control statements: continue)

13 Developing and executing 'C' programs – (By using Decision Making/ Control statements: goto)

14 Developing and executing 'C' programs – (By using Loop Statements/ Iteration statements: while)

15 Developing and executing 'C' programs – (By using Loop Statements/ Iteration statements: do while)

16 Developing and executing 'C' programs – (By using Loop Statements/ Iteration statements: for)

17 Developing and executing 'C' programs – (By using Input/Output Library Functions: unformatted input library functions)

18 Developing and executing 'C' programs – (By using Input/Output Library Functions: unformatted output library functions)

19 Developing and executing 'C' programs – (By using User Defined Functions: Function without arguments and without return statement)

20 Developing and executing 'C' programs – (By using User Defined Functions: Function without arguments and with return statement)

21 Developing and executing 'C' programs – (By using User Defined Functions: Function with arguments and without return statement)

22 Developing and executing 'C' programs – (By using User Defined Functions: Function with arguments and without statement)

23 Developing and executing 'C' programs – (By using Parameter Passing Mechanisms: Call-by-Value, Call-by-Reference)

24 Developing and executing 'C' programs – (By using Local, Global, External Variables)

25 Developing and executing 'C' programs – (By using Recursion)

26 Developing and executing 'C' programs – (By using Arrays: two/double dimensional Arrays)

27 Developing and executing 'C' programs – (By using Arrays: two/double dimensional Arrays)

28 Developing and executing 'C' programs – (By using a String Library Functions)

29 Developing and executing 'C' programs – (By using Pointers, Structures, Unions)

30 Developing and executing 'C' programs – (Implementing a Liked Lists)

31 Developing and executing 'C' programs – (Implementing a Stack, Queue)

32 Practical Examination

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1. Ashok N. Kamthane. 2011. Programming in 'C', 2nd Edition. Pearson Education, New Delhi.
2. Balagurusamy E. 1990. Programming in 'C'. Tata McGraw Hill Publishing Co. Ltd., 12/4 Asaf Ali Road, New Delhi.
3. Mark Allen Weiss. Data Structures and Algorithm Analysis in C++. Pearson Education, New Delhi.
4. Let Us 'C', 2003. Yashwanth Kanethkar, BPB Publications, New Delhi.

AEBE 261 Heat and Mass Transfer 2 (2+0)

Course outlines

Theory

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. Electrical analogy. Insulation materials. Fins, 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. 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. Heat transfer analysis involving conduction, convection and radiation by networks. 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, Flick's law, mass transfer coefficients. Reynold's analogy.

Objectives

To enable the students to know about the transport phenomenon of heat in metals and food products to understand not only the unit operations of food processing but also production aspects of farm machinery.

Lecture

Theory

1 Introduction to heat and mass transfer - applications of heat and mass transfer

2 Modes of heat transfer with examples

3 Thermal conductivity of solids, liquids and gaseous materials

4 Methods for measuring thermal conductivity

5 General differential equation of conduction, one dimensional steady state conduction through plane wall with and without heat generation

6 One dimensional steady state conduction through tubes and cylinder with and without heat generation

7 Conduction through composite walls, tubes and spheres with and without heat generation

8 Critical thickness of insulation for a cylinder

9 Electrical analogy

10 Insulation materials - types and characteristics

11 Heat transfer from extended surfaces (fins), free and forced convection.

12 Newton's law of cooling, heat transfer coefficient in convection

13 Dimensional analysis of free and forced convection

14 Useful of non dimensional numbers

15 Equation of laminar boundary layer on flat plate and in a tube

16 Laminar forced convection on a flat plate and in a tube, combined free and forced convection

17 Unsteady state heat transfer, estimation of heating/cooling time by lumped capacity method

18 Radiation - introduction, absorptivity, reflectivity and transmissivity of radiation

19 Black body and monochromatic radiation, Planck's law

20 Stefan-Boltzman's law, Kirchoff's law, grey bodies

21 Emissive power, solid angle, intensity of radiation

22 Radiation exchange between black surfaces, geometric configuration factor

23 Heat transfer analysis involving conduction by networks

24 Heat transfer analysis involving convection and radiation by networks

25 Types of heat exchangers and their calculations

26 Fouling factor, log mean temperature difference of heat exchangers

27 Heat exchanger performance

28 Heat exchanger - number of transfer units, NTU Method

29 Heat exchanger analysis restricted to parallel flow heat exchangers

30 Heat exchanger analysis restricted to counter flow heat exchangers

31 Steady state molecular diffusion in fluids at rest and in laminar flow

32 Flick's law, mass transfer coefficients, Reynold's analogy

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1. Geankoplis C. J. 1978. Transport Port Processes and Unit Operations. Allyn and Bacon Inc., Newton, Massachusetts.
2. Holman J. P. 1989. Heat Transfer. McGraw Hill Book Co., New Delhi.
3. Incropera F. P. and De Witt D. P. 1980. Fundamentals of Heat and Mass Transfer. John Wiley and Sons, New York.
4. Gupta C. P. and Prakash R. 1994. Engineering Heat Transfer. Nem Chand and Bros., Roorkee.

AEBE 262 Soil Mechanics 2 (1+1)

Course outlines

Theory

Introduction of soil mechanics, field of soil mechanics, phase diagram, physical and index properties of soil, classification of soils, effective and neutral stress, elementary concept of Bousinesq and Westerguards analysis, Newmark influence chart. Seepage analysis; Quick condition - two dimensional flow - Laplace equation, velocity potential and stream function, flow net construction. Shear strength, Mohr stress circle, theoretical relationship between principle stress circle, theoretical relationship between principal stress, Mohr coulomb failure theory, effective stress principle. Determination of shear parameters by direct shear test, triangle test and vane shear test. Numerical exercises based on various types of tests. Compaction, composition of soils, standard and modified protector test, abbot compaction and Jodhpur mini compaction test, field compaction method and control. Consolidation of soil - consolidation of soils, one dimensional consolidation spring analogy, Terzaghi's theory, Laboratory consolidation test, calculation of void ratio and coefficient of volume change, Taylor's and Casagrande's method, determination of coefficient of consolidation. Earth pressure - plastic equilibrium in soils, active and passive states, Rankine's theory of earth pressure, active and passive earth pressure for cohesive soils with simple numerical exercises. Stability of slopes - introduction to stability analysis of infinite and finite slopes friction circle method, Taylor's stability number.

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 and vane shear test; Determination of consolidation properties of soils; Numerical exercises on physical and index properties of soil, numerical exercises on Bousinesqs analysis and New mark influence chart, numerical exercises on shear strength, Numerical exercises on earth pressure, Numerical exercises on stability of slopes.

Objectives

To train on concepts and analysis of soil properties, stress conditions of loaded soil, consolidation and soil failure theories. To impart in higher level design considerations for construction of soil and water conservation structures, irrigation and drainage structures.

Lecture

Theory

1 Introduction of soil mechanics – Field of soil mechanics

2 Soil on three phase systems – physical and index properties of soil

3 Classification of soils

4 Stress condition in soils – effective and neutral stress

5 Concept on Bousinesq's analysis – assumptions, concentrated force, pressure distribution diagrams, isobars, vertical pressure distribution on a horizontal plane

6 Concept on Bousinesq's analysis – vertical pressure distribution on vertical line, vertical pressure under a uniformly loaded circular area, equivalent point load method

7 Westerguard's analysis – comparison between Bousinesq's and Westergaurd's solutions, Preparation of Newmark's influence chart

8 Seepage analysis - Quick condition - two dimensional flow - Laplace equation, velocity potential and stream function, flow net construction.

9 Shear strength – Mohr's stress circle, theoretical considerations, Mohr-Coulomb failure theory

10 Shear strength – Effective stress principle, determination of shear parameters by direct shear test, triangle test and vane shear test

11 Compaction, standard and modified protector test, abbot compaction and Jodhpur mini compaction test and field compaction method and control

12 Consolidation of soil – one dimensional analysis spring analogy, Terzaghi's theory

13 Laboratory consolidation test, calculation of void ratio and coefficient of volume change, determination of coefficient of consolidation

14 Earth pressure - plastic equilibrium in soils, active and passive states, Rankine's theory of earth pressure

15 Active and passive earth pressure for cohesive soils

16 Stability of slopes - introduction to stability analysis of infinite and finite slopes friction circle method, Taylor's stability number

Practical

1 Determination of water content and specific gravity of soil

2 Determination of field density of soil by core cutter method

3 Numerical exercises on physical and index properties of soil

4 Grain size analysis by sieving and hydrometer method

5 Determination of liquid limit by Casagrande's method, plastic limit and shrinkage limit

6 Numerical exercises on Bousinesqs analysis and Newmark influence chart

7 Determination of permeability by constant head and variable head methods

8 Determination of shear parameters by direct shear test

9 Determination of shear parameters by tri-axial test and vane shear test

10 Numerical exercises on determination of shear strength, Mohr's stress circle

11 Determination of compaction properties by standard proctor test

12 Determination of unconfined compressive strength of soil

13 Determination of consolidation properties of soils

14 Numerical exercises on earth pressure

15 Numerical exercises on stability of slopes

16 Practical Examination

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AEBE 263 **Theory of Machines** **2 (2+0)**

Course outlines

Theory

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 centers. 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. 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. 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.

Objectives

To educate the students about the kinematics of machine elements, links and pairs and other systems in different machines for applications in the manufacture of machines and elements.

Lecture

Theory

1 Introduction to Elements, links, pairs, kinematics chain and mechanisms.

2 Introduction to Elements, links, pairs, kinematics chain and mechanisms.

3 Classification of pairs and mechanisms - lower and higher pairs.

4 Classification of pairs and mechanisms - lower and higher pairs.

5 Introduction to four bar chain, slider crank chain and their inversions.

6 Introduction to four bar chain, slider crank chain and their inversions.

7 Introduction to four bar chain, slider crank chain and their inversions.

8 Determination of velocity and acceleration using graphical (relative velocity and acceleration) method, instantaneous centers.

9 Determination of velocity and acceleration using graphical (relative velocity and acceleration) method, instantaneous centers.

10 Types of gears, law of gearing

11 Velocity of sliding between two teeth in mesh

12 Involute and cycloidal profile for gear teeth. Spur gear, nomenclature, interference and undercutting

13 Involute and cycloidal profile for gear teeth. Spur gear, nomenclature, interference and undercutting

14 Introduction to helical, spiral, bevel and worm gear

15 Simple, compound, reverted and epicyclic trains

16 Simple, compound, reverted and epicyclic trains

17 Determining velocity ratio by tabular method

18 Determining velocity ratio by tabular method

19 Turning moment diagrams, coefficient of fluctuation of speed and energy, weight of flywheel, flywheel applications

20 Turning moment diagrams, coefficient of fluctuation of speed and energy, weight of flywheel, flywheel applications

21 Belt drives, types of drives, belt materials

22 Length of belt, power transmitted, velocity ratio, belt size for flat and V belts

23 Effect of centrifugal tension, creep and slip on power transmission, chain drives

24 Effect of centrifugal tension, creep and slip on power transmission, chain drives

25 Types of friction, laws of dry friction, friction of pivots and collars

26 Types of friction, laws of dry friction, friction of pivots and collars

27 Single disc, multiple disc and cone clutches

28 Rolling friction, anti friction bearings

29 Types of governors, constructional details and analysis of Watt, Porter, Proell governors

30 Types of governors, constructional details and analysis of Watt, Porter, Proell governors

31 Effect of friction, controlling force curves, sensitiveness, stability, hunting, iso-chronism, power and effort of a governor

32 Static and dynamic balancing, balancing of rotating masses in one and different planes

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6. Rattan S. B. 1993. Theory of Machines. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

AEBE 264 Electrical Machines and Power Utilization 3 (2+1)

Course outlines

Theory

Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses. Transformer: principle of working, construction of single phase transformer, EMF equation, phasor diagram on load, leakage reactance, voltage regulation, power and energy efficiency, open circuit and short circuit tests, principles, operation and performance of DC machine (generator and motor), EMF and torque equations, armature reaction, commutation, excitation of DC generator and their characteristics, DC motor characteristics, starting of shunt and series motor, starters, speed control methods - field and armature control, polyphase induction motor: construction, operation, phasor diagram, effect of rotor resistance, torque equation, starting and speed control methods, single phase induction motor - double field revolving theory, equivalent circuit, characteristics, phase split, shaded pole motors, various methods of three phase power measurement, power factor, reactive and apparent power, concept and analysis of balanced poly-phase circuits, series and parallel resonance.

Practical

To obtain load characteristics of DC shunt/series/compound generator. To study characteristics of DC shunt/ series motors. To study DC motor starters. To Perform load-test on 3 ph. induction motor & to plot torque v/s speed characteristics. To perform no-load & blocked –rotor tests on 3 phase induction motor to obtain equivalent ckt. parameters & to draw circle diagram. To study the speed control of 3 phase induction motor by cascading of two induction motors i.e. by feeding the slip power of one motor into the other motor. To study star- delta starters physically and (a) to draw electrical connection diagram (b) to start the 3 phase induction motor (c) to reverse the direction of 3 phase I.M. To start a 3-phase slip-ring induction motor by inserting different levels of resistance in the rotor ckt. and to plot torque-speed characteristics. To perform no load & blocked-rotor test on single phase induction motor & to determine the parameters of equivalent ckt. drawn on the basis of double revolving field theory. To perform load-test on single phase induction motor & plot torque-speed characteristics. 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.

Objectives

To impart knowledge to students on the types of electrical machines and motors and generators and power utilization techniques for efficient energy utilization in agriculture, dairy and food processing plants

Lecture

Theory

1 Electromotive force, reluctance, MMF, laws of magnetic circuit, determination of Ampere-turns for series and parallel magnetic circuit

2 Hysteresis - area of hysteresis loop, Steinmetz formula for hysteresis loss

3 Eddy current loss, Steinmetz formula for eddy current loss

4 Single - phase transformer, principle of working, construction, EMF equation

5 Phasor diagram – transformer on-load, no-load, ideal transformer characteristics

6 Leakage reactance, equivalent circuits, voltage regulation, losses in transformer

7 Power efficiency condition for maximum efficiency and energy efficiency

8 Open circuit and short circuit tests in transformer

9 DC Machine - DC Generator, Principle operation constriction of DC generator, yoke, pole shoe, armature, commutator

10 EMF equation, armature winding – lap winding, wave winding, terms used in armature winding

11 Armature reaction, demagnetizing and cross magnetizing Ampere-turns methods of compensating armature reaction – compensating winding, winding of pole shoes

12 Commutation, methods of improving commutation, resistance commutation and EMF commutation

13 Excitation of DC generator – shunt generator, series and compound generator

14 Characteristics of DC generator, separately excited generator, shunt series and compound generator

15 DC Machine - DC motor working principle, construction, back EMF, voltage equation

16 Torque , armature torque, shaft torque, efficiency of DC motor

17 DC Motor characteristics – characteristics of DC series, shunt and compound motor

18 Starting of shunt and series motors

19 Starters - necessity of starter, 3-point starter, 4-point starter

20 Speed control methods - field control and armature control method

21 Poly phase induction motor - construction, operation, rotating magnetic fields, squirrel cage, phase wound rotor

22 Phasor diagram of induction motor, effect of rotor resistance, squirrel cage, phase wound rotor, slip

23 Torque equation, starting – DOL starter, star delta starter and auto transformer starter

24 Speed control methods - control from starter side, rotor side, applied voltage, number of stator poles, rotor rheostat control

25 Single phase induction motor - construction, double field revolving theory

26 Equivalent circuits – without core loss, with core loss, characteristics

27 Phase split and shaded pole motors

28 Various methods of three phase power measurement - single watt meter method, two watt meter method for balance and unbalanced loads three watt meter method

29 Power factor, reactive power, apparent power, disadvantage of low power factor, power factor improvement

30 Concept and analysis of balanced poly phase circuits – star and delta connections relation between voltage and current

31 Series resonant circuits, graphical representation, resonance curve, Q-factor

32 Parallel resonant circuit, graphical representation, Q-factor

Practical

1 To obtain load characteristics of DC shunt generator

2 To obtain load characteristics of DC series generator

3 To obtain load characteristics of DC compound generator

4 To study characteristics of DC shunt motors

5 To study characteristics of DC series motors

6 To study DC motor starters

7 To perform load - test on 3- phase induction motor and to plot torque v/s speed characteristics

8 To perform no-load and blocked – rotor tests on 3-phase induction motor to obtain equivalent circuit, parameters & to draw circle diagram

9 To study the speed control of 3 phase induction motor by cascading of two induction motors i.e. by feeding the slip power of one motor into the other motors

10 To study star - delta starters physically and (a) to draw electrical connection diagram (b) to start the 3-phase induction motor (c) to reverse the direction of 3-phase and to start the 3-phase slip-ring induction motor by inserting different levels of resistance in the rotor circuit and to plot torque – speed characteristics

11 To perform no load and blocked – rotor test on 1-phase induction motor and to determine the parameters of equivalent circuit drawn on the basis of double revolving field theory

12 To perform load-test on 1-phase induction motor and plot torque – speed characteristics

13 To study power consumed in a three-phase circuit

14 Two lights in series controlled by one switch

15 Two lights in parallel controlled by one switch

16 Practical Examination

References

1. Thareja B. L. & Theraja AK. 2005. A Textbook of Electrical Technology. Vol. I S. Chand & company Ltd., New Delhi.
2. Thareja B. L. & Theraja AK. 2005. A Textbook of Electrical Technology, Vol. II. S. Chand & company Ltd., New Delhi.
3. Vincent Del Toro. 2000. Electrical Engineering Fundamentals Prentice-Hall of India Private Ltd., New Delhi.
4. P. S. Bimbhra. 2011. Electrical Machinery, Khanna Publication New Delhi.
5. Anwani M. L. 1997. Basic Electrical Engineering. Dhanpat Rai & Co.(P) Ltd. New Delhi.

AEBE 265 Auto CAD Applications 2 (0+2)

Course outlines

Practical

Application of computers for design. CAD - overview of CAD window, explanation of various options on drawing screen. Study of draw and dimension tool bar. Practice on draw and dimension tool bar. Study of OSNAP, line thickness and format tool bar. Practice on OSNAP, line thickness and format tool bar. Practice on mirror, offset and array commands. Practice on trim, extend, chamfer and fillet commands. Practice on copy, move, scale and rotate commands. Drawing of 2 D - drawing using draw tool bar. Practice on creating boundary, region, hatch and gradient commands. Practice on editing polyline - PEDIT and explode commands. Setting of view ports for sketched drawings. Printing of selected view ports in various paper sizes. 2D - drawing of machine parts with all dimensions and allowances - Foot step bearing and knuckle joint. Sectioning of foot step bearing and stuffing box. Drawing of hexagonal, nut and bolt and other machine parts. Practice on 3D commands on extrusion and loft. Practice on 3D commands on sweep and press pull. Practice on 3D commands on revolving and joining. Demonstration on CNC machine and simple problems.

Objectives

To impart knowledge and skills to the students in computer aided designs involving graphics and machine drawing. The make the students to able to prepare any complicated designs of farm machinery and agricultural and food processing equipment.

Practical

1 Introduction to CAD/CAM and its importance.

2 CAD system components and computer hardware for CAD and explanation of various drafting packages

3 Overview of CAD window – explanation of various toolbars on drawing screen

4 Study of draw tool bar and practice on draw tool bar

5 Study on dimension and dimensional editing tool bar and practice on dimension tool bar

6 Study of OSNAP and application on OSNAP

7 Study on layer command and modifying draftings

8 Practice on mirror, offset and array commands

9 Practice on mirror, offset and array commands

10 Practice on trim, extend, chamfer and fillet commands

11 Practice on trim, extend, chamfer and fillet commands

12 Practice on copy, move and scale commands

13 Practice on rotate and trim commands

14 Drawing of 2 D orthographic projections using draw tool bar

15 Drawing of 2 D orthographic projections and dimensioning using draw tool bar

16 Drawing of isometric projections

17 Practice on creating boundary, region, hatch and gradient commands

18 Practice on creating boundary, region, hatch and gradient commands

19 Practice on editing polyline - PEDIT, Explode and Block commands

20 Practice on editing polyline - PEDIT, Explode and Block commands

21 Setting of view ports for sketched drawings

22 Printing of selected view ports in various paper sizes

23 2D - drawing of machine parts with all dimensions and allowances, Foot step bearing and knuckle joint

24 2D- drawing of machine parts with all dimensions and allowances, Foot step bearing and knuckle joint

25 Sectioning of foot step bearing and stuffing box

26 Drawing of hexagonal, nut and bolt and other machine parts

27 Drawing of hexagonal, nut and bolt and other machine parts

28 Introduction on 3D commands and practice on extrusion and loft commands

29 Practice on 3D commands on sweep, press pull, revolving and joining commands

30 Practice on 3D assembly drawings

31 Demonstration on CNC machine and simple problems

32 Practical Examination

References

1. Rao P. N. 2002. CAD/CAM Principles and Applications. McGraw-Hill Education Pvt. Ltd., New Delhi.
2. Sareen Kuldeep and Chandan Deep Grewal. 2010. CAD/CAM Theory and Practice. S. Chand & Company Ltd., New Delhi.
3. Zeid Ibrahim. 2011. Mastering CAD/CAM with Engineering. McGraw-Hill Education Pvt. Ltd., New Delhi.
4. Lee Kunwoo. 1999. Principles of CAD/CAM/CAE Systems. Addison Vesley Longman, Inc., USA.
5. Mike Mattson. 2002. CNC Programming: Principles and Applications. Cengage Learnings, Delhi.

AEBE 266 **Machine Design** **3 (2+1)**

Course outlines

Theory

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. Cotter joints, knuckle joint and pinned joints, turnbuckle. Design of welded 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. 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. Design of flat belt and V-belt drives and pulleys. Design of gears. Design of screw motion mechanisms like screw jack, lead screw, etc. Selection of anti-friction bearings.

Practical

Problems on working stresses, determination of endurance limit, Design and exercise on knuckle joint, cotter joint, shafts, keys and key ways, leaf springs, ball bearings, roller bearings, hand lever and foot lever, fly wheel, piston rod, connecting rod, crank shaft, cylinder and cylinder head.

Objectives

To enable the students to understand the general procedure for designing any machine part and to know the design of cotter and knuckle joints, levers, springs, various types of shafts, couplings, bearings etc.

Lecture

Theory

1 Machine design – definition, classification of machine design, design considerations, general procedure in machine design

2 Common engineering materials and their mechanical properties

3 Simple stress in machine parts- introduction, types of loads and stresses, Young's modulus, shear stress, shear strain, shear modulus, bearing stress and bearing pressure

4 Simple stress in machine parts- introduction, types of loads and stresses, Young's modulus, shear stress, shear strain, shear modulus, bearing stress and bearing pressure

5 Stress strain diagram, working stress, factor of safety and selection, stress concentration, impact stress, thermal stresses and strains, linear and lateral strain, Poisson's ratio, volumetric strain and resilience

6 Stress strain diagram, working stress, factor of safety and selection, impact stress, thermal stresses and strains, linear and lateral strain, Poission's ratio, volumetric strain and resilience

7 Principle stresses and principle planes - theories of failure under static load, Rankine's theory, Guest's theory, maximum distortion theory and stress concentration

8 Principle stresses and principle planes - theories of failure under static load, Rankine's theory, Guest's theory, maximum distortion theory and stress concentration

9 Introduction to cotter joints, knuckle joint, pinned joints and turnbuckle – importance, working and design procedure

10 Introduction to cotter joints, knuckle joint, pinned joints and turnbuckle – importance, working and design procedure

11 Introduction to cotter joints, knuckle joint, pinned joints and turnbuckle – importance, working and design procedure

12 Introduction to cotter joints, knuckle joint, pinned joints and turnbuckle – importance, working and design procedure

13 Introduction to shafts - material used for shafts, types of shafts, stresses in shafts

14 Design of shafts under torsion and combined bending and torsion

15 Design of shafts under torsion and combined bending and torsion

16 Design of shafts under torsion and combined bending and torsion

17 Introduction to springs - types of springs and functions of springs, design of springs (flat and leaf springs)

18 Introduction to springs - types of springs and functions of springs, design of springs (flat and leaf springs)

19 Introduction to springs - types of springs and functions of springs, design of springs (flat and leaf springs)

20 Introduction to springs - types of springs and functions of springs, design of springs (flat and leaf springs)

21 Introduction to Keys - types of keys, effect of keyways', design of keys. Design of muff, sleeve and rigid flange couplings.

22 Introduction to Keys - types of keys – effect of keyways', design of keys. Design of muff, sleeve, and rigid flange couplings.

23 Introduction to Keys - types of keys – effect of keyways', design of keys. Design of muff, sleeve, and rigid flange couplings.

24 Introduction to Keys - types of keys – effect of keyways', design of keys. Design of muff, sleeve, and rigid flange couplings.

25 Introduction to V-Belts and Pulleys, types, design of flat belt and V-belt drives and pulleys.

26 Introduction to V-Belts and Pulleys, types, design of flat belt and V-belt drives and pulleys.

27 Introduction to bearings - classifications of bearing and Selection of anti-friction bearings

28 Introduction to bearings - classifications of bearing and Selection of anti-friction bearings

29 Introduction to gears – gear terminology, design of gears. Design of screw motion mechanisms like screw jack and lead screw

30 Introduction to gears – gear terminology and design of gears.

31 Design of screw motion mechanisms like screw jack and lead screw

32 Design of screw motion mechanisms like screw jack and lead screw

Practical

1 Problems on working stresses

2 Problems on determination of endurance limit

3 Design of knuckle joint

4 Design of cotter joint

5 Design problems on shafts

6 Design problems on keys and key ways

7 Design problems on leaf springs

8 Design problems on ball bearings

9 Design problems on roller bearings

10 Design problems on hand leaver and foot leaver

11 Design problems on fly wheel

12 Design of piston rod

13 Design problems on connecting rod

14 Design problems on crank shaft

15 Design problems on cylinder and cylinder head

16 Practical Examination

References

1. Jain R. K. 2013. Machine Design. Khanna Publishers, 2-B Nath Market, Nai Sarak, New Delhi.
2. Khurmi R. S. and Gupta J. K. 2014. A Text Book of Machine Design. S. Chand & Company Ltd., New Delhi.

AEBE 267 Thermodynamics, Refrigeration and Air-Conditioning 3 (2+1)

Course outlines

Theory

Thermodynamics properties, closed and open system, flow and non-flow processes, 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, change of entropy of gases in thermodynamics process. Otto, diesel and dual cycles. 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, vapor compression cycles, dry and wet compression, super cooling and sub cooling, vapour absorption refrigeration system, 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. 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 and 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 of 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.

Objectives

To enable the students to know about thermodynamic laws, principles, gas laws and different cycles and to learn low-temperature food processing, cold storage applications, general refrigeration maintenance activities, vapour and ammonia refrigerants.

Lecture

Theory

1 Thermodynamic properties - extensive and intensive properties, classification of thermodynamic systems viz. closed, open and isolated systems

2 Flow and non-flow processes, gas laws – Boyle's law, Charle's law, Regnault's law, Joule's law, laws of thermodynamics – first law, second law and zeroth law, internal energy

3 Application of first law in heating and expansion of gases in non-flow processes – constant volume, constant pressure, hyperbolic process

4 Application of first law in heating and expansion of gases in non-flow processes – constant temperature and adiabatic process

5 Polytropic process, first law applied to steady flow processes, work done in steady flow process in terms of P and V.

6 Carnot cycle and Carnot theorem

7 Entropy, physical concept of entropy, change of entropy of gases in thermodynamics process - constant volume process.

8 Change of entropy of gases in thermodynamics process - constant pressure and constant temperature process

9 Change of entropy of gases in thermodynamic process - adiabatic and polytropic process

10 Otto cycle, diesel cycle and dual cycle

11 Principles of refrigeration - units, terminology, production of low temperatures

12 Air refrigerators working on reverse Carnot cycle

13 Air refrigerators working on Bell Coleman cycle

14 Vapour refrigeration-mechanism, P V, P S, P H diagrams

15 Vapor compression cycles, dry and wet compression

16 Vapour compression cycles, super heating and sub cooling

17 Vapour absorption refrigeration system

18 Common refrigerants and their properties

19 Design calculations for refrigeration system

20 Cold storage plants

21 Thermodynamic properties of moist air, working substance in A.C, Dalton's law of partial pressures, Amagat law of partial volumes, mole fractions of component gases, molecular mass of mixture. Gibb's theorem – molecular masses and gas constants for dry air and water vapour, psychrometric properties

22 Perfect gas relationship for approximate calculation

23 Adiabatic saturation process, wet bulb temperature and its measurement

24 Psychometric chart and its use, elementary psychometric process

25 Air-conditioning – introduction and principles

26 Types of air-conditioning - summer air conditioning, winter air conditioning and functions of air conditioning

27 Physiological principles in air-conditioning

28 Air distribution – Room air distribution, duct design methods – flow through a duct, pressure drop in ducts, frictional losses in ducts, rectangular equivalents of circular ducts, dynamic losses in ducts

29 Fundamentals of design of complete air conditioning systems

30 Humidifiers and dehumidifiers

31 Cooling load calculations

32 Types of air-conditioners and applications

Practical

1 Tutorials on thermodynamic air cycles

2 Study and application of P V and T S chart in refrigeration

3 P H chart (or) Mollier diagram in refrigeration

4 Numericals on air refrigeration cycle systems

5 Numericals on vapour compression cycle refrigeration system

6 Study of domestic water cooler

7 Study of domestic household refrigerator

8 Study of absorption type solar refrigeration system

9 Study of cold storage for fruit and vegetables

10 Freezing load and time calculations for food materials

11 Determination of refrigeration parameters using refrigeration tutor – II

12 Numericals on design of air conditioning systems

13 Study of window air conditioner

14 Study on repair and maintenance of refrigeration and air-conditioning systems

15 Visit to chilling or ice making and cold storage plants

16 Practical Examination

References

1. Kothandaraman C. P. Khajuria P. R. and Arora S. C. 1992. A Course in Thermodynamics and Heat Engines. Dhanpet Rai and Sons, New Delhi.
2. Mathur M. L. and Mehta F. S. 1992. Thermodynamics and Heat Power Engineering. Dhanpat Rai and Sons, New Delhi.
3. Ballney P. L. 1994. Thermal Engineering. Khanna Publishers, New Delhi.
4. Nag P. K.1995. Engineering Thermodynamics. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. Arora, C. P. 2014. Refrigeration and Air Conditioning. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
6. Khurmi R. S. 1992. Engineering Thermodynamics. S. Chand and Co. Ltd., New Delhi.

AEBE 361 Design of Structures 2(1+1)

Course outlines

Theory

Loads and use of BIS Codes. Design of connections. Design of structural steel members in tension, compression and bending. Design of steel roof truss. Analysis and design of singly and doubly reinforced sections, Shear, Bond and Torsion. Design of Flanged Beams, Slabs, Columns, Foundations, Retaining walls and Silos.

Practical

Design and drawing of single reinforced beam, double reinforced beam, Design and drawing of steel roof truss; Design and drawing of one way, two way slabs, Design and drawing of RCC building; Design and drawing of Retaining wall. To measure workability of cement by slump test

Objectives

To acquire knowledge on the design principles of beams, slabs, columns, foundations and RCC structures, retaining walls and silos and other structures.

Lecture

Theory

1 Introduction to loads and BIS codes – loading of a bar, principle of superposition, classification of loaded bar, gradual, sudden, impact and shock loading, tension and compression, axially loaded bar

2 Design of connections- Design of thin cylindrical shells - Failure of thin cylindrical shells, stresses in a thin cylindrical shell, circumferential stress, longitudinal stress, problems on thin cylindrical shells

3 Design of thick cylindrical shells – Lame's theorem, stress, stress in compound thick cylindrical shells, difference of radii of shrinkage, problems on thick cylindrical shells

4 Design of spherical shells, thick spherical shells, problems on thick spherical shells-combined bending and axial thrust-design of steel roof trusses

5 Analysis and designing of single reinforced sections – Properties of reinforced concrete, advantages, assumptions, modular ratio, equivalent area of R.C.C., stress and strain diagram, neutral axis, moment of resistance, design of rectangular section

6 Analysis of balanced over reinforced and under reinforced sections – Under reinforced sections, over reinforced sections, problems

7 Analysis and designing of double reinforced sections – Modular ratio for compression shell equivalent area of steel in compression, neutral axis, moment of resistance, steel beam theory, problems

8 Shear stresses in beams – Shear stress induced in homogeneous and R.C. beams, nominal shear stress, varying depth, effect of shear in R.C. beams, failures, shear resistance of concrete without shear reinforcement

9 Design of shear reinforcement, problems- Vertical stirrups and inclined bars-Design of inclined-Vertical stirrups and inclined bars- Design of inclined bars- critical section for shear, problems.

10 Bond and development of length – Development of length, development of stress in R.C.C. Anchorage for reinforced bars-in tension and compression.

11 Curtailment of bars – Decision on the curtailment of bars, design considerations for bond, general concept of bond. Design of flanged beams

12 Design of one way slabs – Loading on slabs, arrangement of reinforcement, problems-design of reinforced brick slabs, problems

13 Design of two way slabs – Rankine – Grashoff theory, shear force on the edges, design, problems, Merco's method-Torsion reinforcement, load and bending moment problems-slabs with edges fixed.

14 Axially loaded columns – Types of columns, effective length of columns, long and short columns, composite columns- basic rules for design of columns- arrangement of transverse reinforcement- Problems-Foundations-Types of foundations, design criteria-problems.

15 Retaining walls – Earth pressure on a retaining wall, active earth pressure, passive earth pressure-Stability of walls-conditions for stability of retaining walls, problems.

16 Silos, circular or cylindrical tanks and design criteria – Permissible stresses in concrete, permissible stresses in steel, base, minimum reinforcement, design, problems-circular tanks with rigid joints –H. Carpenter's method, problems

Practical

1 Design and drawing of single Reinforced beam

2 Design and drawing of double Reinforced beam

3 Design and drawing of T- beams

4 Design and drawing of R.C.C. Columns

5 Design and drawing of shear reinforcement

6 Design and drawing of one way slabs

7 Design and drawing of two way slabs

8 Design and drawing of R.C.C. Building

9 Design and drawing of footing

10 Design and drawing of grillage foundation

11 Design and drawing of steel roof truss.

12 Design and drawing of Retaining wall

13 To determine compression & tensile strength of cement after making cubes and briquettes

14 To measure workability of cement by slump test

15 To measure workability of cement by compaction factor test

16 Practical Examination.

References

1. Junarkar, S. B. 2001. Mechanics of Structures Vol. I Charotar Publishing Home, Anand.

2. Khurmi R. S. 2001. Strength of materials. S. Chand & Company Ltd., New Delhi.

3. Kumar Sushil 2003. Treasure of R. C. C. Design. R.K. Jain. Delhi.

AEBE 362 Building Construction and Cost Estimation 2(2+0)

Course outlines

Theory

Building materials - rocks, stones, bricks properties and varieties of tiles, lime, cement, concrete, sand, glass, rubber, plastics, iron, steel, aluminum, copper, nickel, timber. Building components - lintels, arches, stair cases, different types of floors. Finishing - damp proofing and water proofing, plastering, pointing, white washing and distempering – painting. Building design, design procedures and their technology. Building construction - types of agricultural buildings

and related needs, application of design theory and practice to the conservation, sloped and flat roof buildings. Construction economics - preliminary estimates, detailed Estimates of buildings source of cost information, use of cost analyses for controlling design, Factors affecting building costs, cost evaluation of design and planning alternatives for building and estate development, measurement and pricing. Economic methods for evaluating investments in buildings and building systems - cost-in-use, benefit-to-costs and savings-to-investment ratios, rate of return, net benefits, payback period.

Objectives

To enable the students to know about different materials used for engineering constructions like buildings, roads, farm structures and metals and other materials for manufacturing farm equipment, implements, dairy and food processing equipment and construction economics including economic methods for evaluating investments in buildings. Also useful for students in the cost estimation.

Lecture

Theory

1 Introduction to building materials, list of building materials

2 Rocks / stones - types uses for various civil constructions and other engineering uses

3 Bricks – types and their properties, manufacturing processes. Tiles- types and properties of tiles

4 Lime - uses of lime, lime concrete, preparation and its strength

5 Cement – types and their properties, Concrete - uses of concrete, various grades, preparation of concrete mix and their strengths aspects

6 Sand, glass, rubber, plastics their types and properties

7 Iron, steel, aluminum, copper, nickle, timber - types and their properties and their usage as building materials.

8 Building components – types, foundation, flooring, walls and roof

9 Lintels, Arches – components, types of lintels, terminology connected, design criteria

10 Stair cases – types, principles in keeping the stair case and construction procedure

11 Different types of floors - thickness of the floor, requirement of a good floor, specification of floors, tiles, marbles, bricks

12 Finishing - wall finishing, slab finishing, floor finishing

13 Damp proofing and water proofing for floors and slabs, latest additions in DPC- their usage and importance in the building aesthetics and hygiene

14 Plastering and pointing - The places of pointing examples, brick pointing, granite masonry pointing, the art involved in pointing work, specifications

15 White washing and distempering – Painting, types of paints- varnishes, distempers used for buildings, tools and equipment used for white washing and paintings

16 Building design, design procedures - considerations to be taken care before taking up any building like water demand, floor requirements, ventilation, strength requirement for all the dimensions of walls, slabs, beams, columns and pillars

17 Technology, building construction, procedures

18 Types of agricultural buildings and related needs, farm houses, workshop, poultry sheds, dairy barns

19 Design of a farm house and workshop

20 Design of a poultry and dairy barn

21 application of design theory and practice to the conservation

22 sloped and flat roof buildings, trusses, slabs

23 construction economics – logistics, criteria for fixing the building cost based on its utility and life expectancy

24 Preliminary estimates – types, procedure of arriving at final estimate cost

25 Detailed Estimates of Buildings - calculation of quantities and abstract estimate, specifications to be followed in filling the columns of the estimate table for various items

26 Source of cost information - SSR, local prevailing rates or nearby available source

27 Use of cost analysis for controlling design

28 Factors affecting building costs

29 Cost evaluation of design and planning alternatives for building and estate development

30 Measurement and pricing

31 Economic methods for evaluating investments in buildings and building systems and annuity factors

32 Cost-in-use, benefit-to-costs and savings-to-investment ratios, rate of return, net benefits, payback period

References

1. Punmia B. C. Ashok Kumar Jain and Arun Kumar Jain. 2016. Building Construction. Laxmi Publications (P) ltd., New Delhi.
2. Duggal S. K. 2012. Building material. New Age International Publishers, New Delhi.
3. Sane Y. S. Planning and Designing of Buildings.
4. Rangwala S. C. 1994. Engineering Materials. Charotar Publishing House, Anand.
5. Dutta B. N. 2000. Estimating and Costing. UBS publishers, New Delhi.

AEBE 363 Web Designing and Internet Applications 2 (1+1)

Course outlines

Theory

Basic principles in developing a web designing, 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 (WWW), creation of a web site, web standards, audience requirement. Introduction to Java script, variables & functions, working with alert, confirm and prompt, connectivity of web pages with databases. Project.

Practical

FLASH - animation concept FPS, Understanding animation for web, flash interface, working with tools, DREAM WEAVER - exploring dream weaver 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.

Objectives

The aim of this course is to provide the conceptual and technological developments in the field of Internet and web designing with the emphasis on comprehensive knowledge of Internet. To emphasis on basic concepts of web design. Clear understanding of hierarchy of objects in HTML and will able to write html, JavaScript, CSS codes and finally to create good, effective and customized websites. To know internet related technologies and systematic way of developing a website.

Lecture

Theory

1 Basic principles in developing a web designing – Purpose, Communication, typefaces, colours, images, navigations, grid based layouts, 'F' pattern design, load time, mobile friendly

2 Planning process of the web designing – information gathering, planning, design, development, testing and delivery, maintenance

3 Five Golden rules of web designing – Define website goals, highlight your brand image, identify target audience, analyze competitor websites, evaluate and improve

4 Designing navigation bars – HTML/CSS Navigation bars

5 Page design steps and home page layout in HTML/CSS

6 Basics in web design

7 Brief history of internet – origin, purpose and applications of internet.

8 World Wide Web(W3C) – history and overview, fundamental technologies of WWW: HTML, URL, HTTP

9 Creation of a web site – Plan your content, Wireframe your design, Create web pages, Publishing your website.

10 Web standards – HTML, CSS, XML, XHTML.

11 Categories of audience requirement for web designing – "To Do" and "To View"

12 JavaScript – Introduction to JavaScript

13 JavaScript – variables and functions in JavaScript

14 Dialog Boxes – working with alert, confirm and prompt dialog boxes

15 Connectivity of web pages with databases (SQL/Microsoft Access)

16 Project – Designing a website by creating web pages in HTML

Practical

1 FLASH – animation concept FPS (Frames Per Second)

2 Understanding animation for web using HTML/CSS/JavaScript

3 Flash interface – planning the interface, wire framing your design, understanding layer ordering, naming and arranging layers, effective use of gradients

4 Working with tools – different web designing tools

5 Dreamweaver – installation and exploring dream weaver interface

6 Planning & setting website structure

7 Dreamweaver – Working with panels in dream weaver/HTML

8 Understanding & switching views in dream weaver

9 Dreamweaver – using property inspectors and formatting in text

10 JavaScript – understanding operators, arrays and functions

11 JavaScript/HTML – creating rollover images

12 GIF(Graphics Interchange Format) – creating animation using animation makers, understanding .gif file, knowing .gif file format

13 Learning to use FTP (File Transfer Protocol), Uploading of site, Using Control Panel

14 Creating basic web banner, web banner with effects

15 Creating animated web buttons

16 Practical Examination

References

1. Jennifer Niederst Robbins. Developing web design latest edition. O'REILLY, 3rd Edition.
2. Frain and Ben. Responsive Web Design with HTML5. [PACKET] Publishing.
3. Nicholas C. Zakas. Java Script for Web Developers. 3rd Edition.
4. George Q. Huang, K. L Mak. Internet Applications in Product Design and Manufacturing. ISBN: 3540434658.
5. Tanenbaum,Wetherall. 2011. Computer Networks. 5th Edition. Pearson Education. Inc. New Delhi.
6. Deitel & Deitel. 2011. Internet & World Wide Web – How to Program, 5th Edition. Pearson Education. Inc. New Delhi.

Department of Applied Sciences

AEAS 171 **Engineering Mathematics – I** **3 (2+1)**
(Matrices and Calculus)

Course outlines

Theory

Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalization of matrices, quadratic forms. PAQ form, Echelon form, Solution of linear equations, nature of rank, using Cayley-Hamilton theorem to find inverse of A. Differential calculus: Taylor's and Maclaurin's expansions; indeterminate form; curvature, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, maxima and minima. Integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration, application of double and triple integrals to find area and volume. 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 proofs).

Practical

Tutorials on rank of a matrix, reduction to normal form, consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem, diagonalization of matrices, quadratic forms; Taylor's and Maclaurin's expansion, indeterminate form, curvature, tracing of curves, partial differentiation, maxima and minima, volume and surface of revolution, multiple integrals, Beta and Gama functions, differentiation of vectors, gradient, divergence and curl of a vector point function, line, surface and volume integrals, Stoke's divergence and Green's Theorems.

Objectives

To impart the knowledge on advanced aspects of engineering calculus to enable the students to apply for solving the engineering problems in the courses of agricultural engineering

Lecture

Theory

1	Matrices: Review of matrices-Elementary transformation
2	Rank of matrix, finding Rank of matrix by reduction to Echelon form
3	Finding Rank of matrix by reduction to normal form
4	Finding Rank of matrix by reduction to PAQ form
5	Gauss-Jordon method to find inverse of a matrix
6	Nature of rank and Solution of linear equations
7	Eigen values and Eigen vectors and properties
8	Finding Eigen values and Eigen vectors of a Matrix
9	Finding Eigen values and Eigen vectors of a symmetric Matrix
10	Cayley-Hamilton theorem and verification
11	Finding inverse of a Matrix using Cayley-Hamilton theorem
12	Diagonalization of matrices by Linear transformation
13	Diagonalization of matrices by Orthogonal transformation
14	Quadratic forms, reduction of Quadratic form to Canonical form
15	Differential calculus: Taylor's and Maclaurin's expansions
16	Indeterminate Forms
17	Curvature and Radius of Curvature variables
18	Function of two or more independent ,Partial differentiation
19	Homogeneous functions, Euler's theorem
20	Composite functions, Total derivatives
21	Maxima minima of function of two independent variables
22	Integral calculus: Volumes and surface of revolution of curves
23	Double integrals
24	Triple integrals
25	Change of order of integration
26	Application of double and triple integrals to find area and volume
27	Vector calculus: Differentiation of vectors, Vector differential operator Del Gradient of a scalar point function
28	Divergence and curl of a vector point function
29	Identities involving Del, second order differential operator
30	Line, surface and volume integrals

31 Green's theorem and Stoke's theorem

32 Gauss Divergence theorem

Practical

1 Problems on rank of a matrix

2 Problems on Rank of matrix by reduction to normal form

3 Consistency and problems on solution of linear equations

4 Problems on Eigen values and Eigen vectors of a matrix

5 Problems on Eigen values and Eigen vectors of a symmetric Matrix

6 Problems on Cayley Hamilton theorem

7 Problems on reduction of Quadratic form to Canonical form by orthogonal transformation

8 Problems on reduction of Quadratic form to Canonical form by linear transformation

9 Problems on Taylor's and Maclaurin's expansions

10 Problems on indeterminate forms

11 Problems on tracing of curves

12 Problems on maxima and minima & Beta and Gamma functions

13 Problems on gradient, divergence and curl of a vector point function

14 Problems on line, surface and volume integrals

15 Problems on Green's, Stoke's and Gauss divergence theorems

16 Practical Examination

References

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3. Narayan Shanti. 2005. Integral Calculus, S. Chand and Co. Ltd. New Delhi.

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AEAS 172 Engineering Physics 3 (2+1)

Course outlines

Theory

Dia, Para and ferromagnetism-classification. Langevin theory of dia and paramagnetism. Adiabatic demagnetization. Weiss molecular field theory and ferromagnetism. Curie-Weiss law. Wave particle quality, de-Broglie concept, uncertainty principle. Wave function. Time dependent

and time independent Schrodinger wave equation, Qualitative explanation of Zeeman effect, Stark effect and Paschan Back effect, Raman spectroscopy. Statement of Bloch's function. Bands iii solids, velocity of Bloch's electron and effective mass. 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 Tc superconductors. Spontaneous and stimulated emission, Einstein A and B coefficients. Population inversion, He-Ne and Ruby lasers. Ammonia and Ruby masers, Holography-Note. Diffraction-Types, intensity, grating, polarization laws. Optical fiber. Physical structure. Basic theory. Mode type, input output characteristics of optical fiber and applications. Illumination: laws of illumination, luminous flux, luminous intensity, candle power, brightness.

Practical

To find the frequency of A.C. supply using an electrical vibrator; To find the low resistance using Carey Foster bridge without calibrating the bridge wire; To determine dielectric constant of material using De Sauty's bridge; To determine the value of specific charge (e/m) for electrons by helical method; To study the induced emf as a function of velocity of the magnet; To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities; To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil; 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 find the numerical aperture of optical fiber: To set up the fiber optic analog and digital link; To study the phase relationships in L.R. circuit; To study LCR circuit; To study the variations of thermo emf of a copper-constantan thermo-couple with temperature; To find the wave length of light by prism.

Objectives

To give insight to students about magnetism, semiconductors and optics required for engineering studies related to instrumentation, operation of equipment and controls.

Lecture

Theory

1 Classification of Dia, Para, and ferromagnetic substances, its characteristics, orbital angular momentum

2 Langevins theory of Dia magnetism (derivation)

3 Langevins theory of Para magnetism (derivation)

4 Weis molecular field theory of para magnetism

5 Weis theory of ferromagnetism domine theory Adiabatic demagnetization

6 Wave nature of matter – wave particle duality, de-broglies concept, de-broglie wave length, Properties of matter waves.

7 Wave velocity, group velocity, particle velocity, their relation, uncertainty principle.

8 Properties of wave function, schrodingers time dependent and time independent wave equation.

9 Spectroscopy – Zeeman effect, classical theory of Zeeman effect related problems

10 Explanation of paschen back effect and stark effects, larmour precession, related problems

11 Raman effect, quantum theory of Raman effect, related problem

12 Band theory of Solids – Energy bands in solids, Free electron theory, one dimensional periodic potential

13 Bloch's function, effective mass of electron and hole, velocity of Block electron, Variation of e,v,m* and fk with k

14 Semiconductors – Distinction between metals, insulators and semiconductors, Intrinsic and Extrinsic semiconductor

15 Donors and acceptors levels, law of mass action, determination of energy gap in semiconductor

16 Super conductivity – qualitative explanation, critical magnetic field, Meissner effect, Isotope effect

17 Type-I and Type – II superconductors

18 Josephsons effect, DC Josephsons effect, AC. Josephson effect

19 Introduction to high temperature super conductors, SQUIDS

20 Lasers – Spontaneous emission, stimulated emission, Einstien coefficients A and B their relation

21 Construction and working of He-Ne laser. Construction and working of rubylaser

22 Construction and working of Ammonia maser, Ruby maser Holography-Note

23 Optical Fibre-Physical structure, BASIC THEORY, Numerical aperture acceptance angle

24 Types of optical fibre, characteristics and applications

25 Optics – Interference, at thin films, Newton rings

26 Michelsons inter ferrometer, construction, working, measurement of wavelength

27 Diffraction – Fresnel diffraction, rectilinear propagation of light, Zone plate

28 Fraunhofer diffraction due to single slit, intensity distribution

29 Diffraction grating, dispersive power, resolving power of grating

30 Polarization – Brewsterslaw, law of malus, Double refraction-optical activity, polarimeter

31 Laws of illumination: Lamberts law of inverses squares, Lamberts cosine law, Candle power

32 Luminous flux, Lumen, Brightness, Lummer and Brotdhum Photometer

Practical

1 To find the frequency of A.C. supply using an electrical vibrator

2 To find the low resistance using carey Foster bridge without calibrating the bridge wire

3 To determine dielectric constant of material using De Sauty's bridge

4 To determine the value of specific charge (e/m) for electrons by helical method

5 To study the induced e.m.f. as a function of velocity of the magnet

6 To obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities

7 To study the variation of magnetic field with distance along the axis of a current carrying circular coil and to determine the radius of the coil

8 To determine the energy band gap in a semiconductor using a p-n junctindoide

9 To determine the slit width from Framhofer diffraction pattern using laser beam

10 To find the numerical aperture of optical fiber.

11 To set up the fiber optic analog and digital link

12 To study the phase relationships in L.R. circuit and LCR circuit

13 To study the variations of thermo emf of a copper-constantan thermo-couple with temperature

14 To find the wave length of light by prism

15 Determination of specific rotation of sugars

16 Practical Examination

References

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4 Saxena B. S. and Gupta R. C. 2000. Solid State Physics. Pragati Prakasam, Meerat.

5 Srivastava B. N. 1980. Essentials of Quantum Mechanics. Pragati Prakasam, Meerat.

6 Vasudeva D. N. S. 2002. Fundamentals of Magnetism and Electricity. Chand and Co., New Delhi.

7 Gupta and Kumar. 2015. Hand Book of Electronics. Pragati Prakasam, Meerat.

8 Gupta and Gupta. 2013. Electronics Devises and Circuits. S. K. Kataria & Sons. New Delhi.

AEAS 173 **Engineering Chemistry** **3 (2+1)**

Course outlines

Theory

Phase rule and its application to one and two component systems. Fuels: classification. calorific value. Colloids: classification. properties. Corrosion: causes. types and method of prevention. Water: temporary and permanent hardness. disadvantages of hard water, scale and sludge formation in boilers, boiler corrosion. Analytical methods like thermo-gravimetric. polarographic analysis. nuclear radiation. detectors and analytical applications of radioactive materials. Enzymes and their use in the manufacturing of ethanol and acetic acid by fermentation methods. Principles of food chemistry. Introduction to lipids, proteins, carbohydrates, vitamins, food preseltators, colouring and flavouring reagents of food. Lubricants: properties. mechanism. classification and tests. Polymers. types of polymerization. properties. uses and methods for the determination of molecular weight of polymers. Introduction to IR spectroscopy.

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 Xnax 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.

Objectives

To study the chemical aspects of engineering materials and processes such as phase rule, ionization, corrosion, lubricants, etc. which will give good insight to the students to go for engineering applications in agricultural engineering industries.

Lecture

Theory

1 Phase rule: definition-equation-explanation of the terms involved- degrees of freedom-component- two component system (silver & lead component system)- eutectic point-triple point

2 Phase rule: definition-equation-explanation of the terms involved- degrees of freedom-component- two component system (silver & lead component system)- eutectic point-triple point

3	Colloids: classification of colloidal systems-properties-applications
4	Fuels-introduction-classification-calorific value
5	Corrosion-chemical theory-reactions-definition-chemical / dry corrosion-wet / electro chemical corrosion-factors influencing corrosion-galvanic series
6	Corrosion-chemical theory-reactions-definition-chemical / dry corrosion-wet / electro chemical corrosion-factors influencing corrosion-galvanic series
7	Protection against corrosion-anodic and cathodic protection-application of surface coatings-metallic-inorganic-organic coating
8	Water-types of hardness(temporary and permanent)- units of hardness-equivalents of calcium carbonate-disadvantages of hard water in domestic use- industrial use
9	Disadvantages of hard water- in steam generation in boilers-scale & sludge formation in boilers-caustic embrittlement-boiler corrosion-priming & foaming
10	Softening methods-Lime-soda process-zeolite / permutit process-ion exchange or de-ionization-mixed bed deionizer-advantages-limitations
11	Nuclear radiation-Types of radiations-a,ß,?- detectors of radioactivity- Ionization chamber-Geiger Muller Counter- Scintillation Counter
12	Applications of radioactive materials - in agriculture-in industry -as tracers in biological studies
13	Lubricants-functions-mechanism of lubrication-classification of lubricants
14	Important properties of lubricating oils-viscosity-flash and fire points-cloud and pour point-emulsification-volatility-specific gravity-carbon residue-neutralization number-precipitation number-ash content- Aniline point-mechanical stability
15	Polymers: types of polymerization-addition-condensation-co-polymerization plastics/ resins-types-thermo setting and thermoplastic resins
16	Methods for determination of molecular weight of polymers-number average molecular mass-weight average molecular mass-viscosity average molecular mass
17	Infrared spectroscopy-introduction-theory- applications of IR spectroscopy
18	Food chemistry-definition-introduction-importance and history of food chemistry
19	Lipids – Fatty acids- saturated and unsaturated-essential and non essential fatty acids-classification of lipids
20	Lipids –properties like Rancidity-saponification- hydrogenation-iodine number- Reichert Meissl number-acid value.
21	Carbohydrates- introduction- definition- structure & classification-mono-oligo-polysaccharides
22	Carbohydrates-physical properties- stereo isomerism-enantiomers-epimers-anomers-mutarotation

23 Amino acids – structures- classification –protein and non protein amino acids-essential and non-essential amino acids- oligo peptides

24 Proteins –importance-properties of proteins-UV absorption–zwitterions-Isoelectric point – denaturation- renaturation-solubility-Structural organisation-primary, secondary, tertiary and quaternary structures and forces involved in stabilizing proteins

25 Enzymes – characteristics of enzymes – chemical nature, speed, specificity, active site – activation energy –measurement of enzyme activity- coenzymes-Prosthetic group-Inorganic ions

26 Nomenclature and classification of enzymes- Factors effecting enzyme activity

27 Vitamins-water soluble and fat soluble –dietary sources and deficiency symptoms

28 Use of enzymes in manufacturing of ethanol

29 Manufacturing of acetic acid by fermentation method

30 Food preservatives-natural preservatives-chemical preservatives-their chemical action on foods and human system

31 Food colours-Natural food colours-synthetic food colours-types-their chemical nature-their impact on health

32 Flavouring agents-natural flavours & synthetic flavours-examples & their chemical nature-role of flavouring agents in food processing

Practical

1 Determination of temporary hardness of water by EDTA method

2 Determination of permanent hardness of water

3 Estimation of chloride in water

4 Estimation of dissolved oxygen in water-Titrimetric method

5 Determination of BOD & BOD in water sample

6 Determination of viscosity of oil

7 Estimation of acidity and alkalinity of water sample

8 Estimation of water activity of food sample

9 Determination of carbonate and bi-carbonate ions in water

10 Determination of specific rotation of an optically active compound-polarimetry

11 Verification of Beer-Lambert' law

12 Determination of calorific value of fuel-Bomb calorimeter

13 Identification of functional groups (alcohol, aldehyde, ketones, carboxylic acid and amide) by IR spectroscopy-mode of operation

14 Separation of sugars and amino acids by paper chromatography/ Characterization of lipids by Thin layer chromatography

15 Separation of sugars and amino acids by paper chromatography/ Characterization of lipids by Thin layer chromatography

16 Practical Examination

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AEAS 174 Principles of Agronomy and Organic Farming 3 (2+1)

Course outlines

Theory

Introduction and scope of agronomy. Classification of crops, Effect of different weather parameters on crop growth and development. Principles of tillage, tilth and its characteristics. Crop seasons. Methods, time and depth of sowing of major field crops. Methods and time of application of manures and fertilizers. Organic farming-Sustainable agriculture. Soil water plant relationship, crop coefficients, water requirement of crops and critical stages for irrigation, weeds and their control, crop rotation, cropping systems, Relay cropping and mixed cropping.

Practical

Identification of crops and their varieties, seeds, manures, fertilizers and weeds; Fertilizer application methods; Different weed control methods; Practice of ploughing, Practice of Puddling, Practice of sowing.

Objectives

To enable the students to understand the farming principles to grow agricultural crops and orchard crops and all farming practices. To understand the soil, crop and machine specific parameters for design and development of farm machinery, equipment and implements, seed processing equipment and soil and water engineering activities for efficient water and land productivity and upcoming organic farming activities.

Lecture

Theory

1 Meaning and scope of Agronomy-History of Agriculture development in Ancient India-Agriculture in civilization Era.

2 National and International Agricultural Research Institutes in India.

3 Classification of crops: Classification of field crops-according to origin, botanical, commercial, economical, seasonal, ontogeny, agronomic, leaf morphology and special purpose crops.

4 Definition of climate and weather: - composition and structure of atmosphere.

5 Definition of Meteorology, Climatology, Agricultural Meteorology introduction, scope and practical utility of Agricultural meteorology.

6 Influence of weather on crop growth and development.

7 Essential resources for crop production-factors influencing plant growth-Biotic and Abiotic factors.

8 Agro-climatic zones of Andhra Pradesh and India

9 Crop seasons – Kharif, Rabi and summer seasons in Andhra Pradesh

10 Tillage and Tilth – objectives of tillage, characteristics of good seed-bed and effect of tillage on soil properties (pore space, texture, bulk density, colour of the soil).

11 Types of tillage – preparatory cultivation, inter cultivation, after cultivation and preparatory cultivation for lowland rice puddling, zero tillage

12 Implements used for seed bed preparation, sowing, inter-cultivation and special operations.

13 Sowing – methods, time and depth of sowing of major field crops.

14 Methods and time of application of manures and fertilizers

15 Weeds – influence of weeds on crop production, principles and practices of weed management.

16 Basics on soil plant-water relationship- Effective root zone depth, critical stages of irrigation, moisture extraction pattern.

17 Crop coefficients, water requirement of crops and critical stages for irrigation.

18 Crop rotation, cropping systems, Relay cropping and mixed cropping.

19 Types of soil erosion – soil conservation-erosion preventive measures. Agronomic measures for soil and water conservation.

20 Dryland agriculture – problems of crop production in dry farming – agronomic measure in reducing evapo- transpiration losses.

21 Watershed management – aims and objectives.

22 Crop Husbandry practices of Rice, Maize, cotton and Groundnut

23 Organic farming – definition – need – scope – principles – characteristics - relevance to modern agriculture.

24 Different eco friendly farming systems- Biological farming, natural farming, Regenerative agriculture – permaculture - Biodynamic farming.

25 Relevance of organic farming to India, A.P and global agriculture and future prospects-advantages - barriers to organic farming. Sustainable Agriculture-Definition and concepts.

26 Organic nutrient sources and its fortification – organic manures- methods of composting

27 Green manures- bio fertilizers – Types, methods of application – Benefits and limitations. Nutrient management in organic farming.

28 Fundamentals of insect, disease and weed management under organic mode of production-cultural- biological methods- Non chemical pest and disease management.

29 Botanicals- pyrethrum, neem seed kernel extract, neem seed powder, soluble neem formulations, neem oil.

30 Inspection – certification - labelling and accreditation procedures for organic products.

31 Processing, - economic consideration and viability.

32 Marketing and export potential of organic products – national economy.

Practical

1 Visit to college farm

2 Study of meteorological instruments

3 Measurement of rainfall and evaporation

4 Practice of ploughing

5 Practice of puddling

6 Seed bed preparation and sowing

7 Identification of crops and seeds

8 Identification of manure and fertilizers

9 Calculation of the fertilizer based on the nutrient requirement of the crops.

10 Practice of inter-cultivation and weeding

11 Vermi compost preparation

12 Preparation of neem products and other botanicals for pest and disease control

13 Preparation of different organic sources of nutrients and pesticides

14 Visit to organic clusters and bio control lab to study the maintenance of bio-fertilizers/ bio-inoculant cultures

15 Visit to organic farms to study the various components and their utilization

16 Practical examination

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AEAS 175 Communication Skills and Personality Development 2 (1+1)

Course outlines

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; 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, 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.

Objectives

To develop the comprehension and communication skills of students in English. To make, the students to able to have a clear concept of communication skills in English by using AV aids and ICT. Also to improve the reading skills and capable to present the cases individually as well as improvement in confidential levels of the students in attending the group discussions and interviews.

Lecture

Theory

1 Communication skills – Meaning & process of communication; verbal and non-verbal communication; Structural & functional grammar; Tense; Active voice & Passive voice;

2 Direct speech & Indirect speech; Articles & prepositions; Parts of speech.

3 Listening & note taking – Development of listening skills, Writing skills, Oral presentation skills & Precis writing skills.

4 Field dairy & lab record; Indexing, footnote & bibliographic procedures

5 Reading & comprehension of general & technical articles

6 Summarizing & abstracting; Individual & Group presentations

7 Impromptu presentation & public speaks

8 Group discussion; Role of ICT in communication skills

9 Recent advances in communication – Print & electronic media, Internet, Email, Fax, Mobile; Interactive video & teleconferencing of communication

10 Computer – e – governance of communication

11 Introduction of Personality development - Definition and types of personality

12 Personality disorders

13 Theories of personality development

14 Personality assessment tests – Big 5 factors, 16 PF, TAT

15 Leadership – Definition and styles; Attributes of an effective leader

16 Dressing for formal & informal occasions

Practical

1 Listening and Note Taking – Developing Listening Skills – Practice

2 Writing Skills – The style , choice of words and Phrases, clichés, jargons, foreign words and phrases - Practice

3 Oral Presentation Skills – Oral Presentation by students, Articulation and Delivery; Evaluation sheet for Oral Presentation – Practice

4 Field Diary and Lab Record – by students

5 Reading and Comprehension of General Articles and using different types of reading skills - Practice

6 Précis writing – Summarizing & Abstracting – Practice

7 Individual and Group Presentation - Practice

8 Impromptu Presentation & Impromptu Speaking – Practice

9 Public Speaking – Practice

10 Group Discussion – Practice

11 Organizing Seminars and Conferences –Checklist for organizing workshops - Practice

12 To Study the impact of physique on personality and collection of data

13 Report writing and presentation

14 Observation visit to personality development institutions

15 Guest lecture by personality development speakers

16 Practical Examination

References

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AEAS 176 **Engineering Mathematics – II** **3 (2+1)**

(Differential Equations)

Course outlines

Theory

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, 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. Functions of a Complex variable: Limit, continuity and analytic function, Cauchy-Riemann equations, Harmonic functions. Infinite series and its convergence, periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series, Harmonic analysis. Fourier Sine and Cosine Series, Fourier series for function having period 2L, Elimination of one and two arbitrary function. Partial differential equations: Formation of partial differential equations, Higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, application of partial differential equations, one dimensional wave and heat flow equations, Laplace Equation.

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.

Objectives

To impart knowledge of different mathematical methods to form and solve differential equations for applications in solving the engineering problems in the fields of fluid mechanics, hydrology, drainage, heat and mass transfer and unit operations

Lecture

Theory

1 Ordinary differential equations: Review of Differential Equations

2 Solution of Bernoulli's differential equations

3 Solution of Exact differential equations

4 Solution of Equations reducible to exact form by integrating factors

5 Solution of Equations of first order and higher degree

6 Solution of Clairaut's equation

7 Differential equations of higher orders, Methods of finding Complementary functions

8 Methods of finding Particular Integrals

9 Method of variation of parameters

10 Solution of Cauchy's and Legendre's linear equations

11 Solution of Simultaneous linear differential equations with constant coefficients

12 Series solution techniques of differential equations

13 Bessel's differential equation

14 Legendre's differential equation

15 Complex Analysis :Functions of a Complex variable, Limit of functions, Continuity

16 Analytic functions, Cauchy-Riemann equations

17 Harmonic functions

18 Infinite series

19 Convergence of Infinite series

20 Fourier series :Periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions

21 Fourier series for function having arbitrary period 2L

22 Fourier series of Even and odd functions

23 Half range series, Fourier Sine and Cosine Series

24 Harmonic analysis

25 Partial differential equations: Formation of partial differential equations by elimination of arbitrary constants

26 Formation of partial differential equations by elimination of one or two arbitrary function

27 Solutions of Linear Partial differential equations of first order (Lagrange's Method)

28 Higher order linear partial differential equations with constant coefficients

29 Solution of non-linear partial differential equations

30 Charpit's method

31 Application of partial differential equations to one dimensional wave equation

32 Application of partial differential equations to one dimensional heat flow and Laplace Equation.

Practical

1 Problems on Bernoulli's differential equations

2 Problems on Exact and Non exact differential equations

3 Problems on Series solutions of differential equations.

4 Problems on Bessel's differential equations & Legendre's differential equations

5 Problems on Convergence of infinite series

6 Problems on Fourier series for functions having arbitrary period 2L

7 Problems on Fourier Sine and Cosine Series

8 Problems on Cauchy-Riemann equations

9 Problems on Analytical and Harmonic functions

10 Problems on Higher order linear partial differential equations with constant coefficients

11 Problems on Lagrange's Linear equations

12 Solutions of Non-Linear partial differential equations

13 Problems on Charpit's method

14 Problems on one dimensional wave equation

15 Problems on one dimensional heat flow and Laplace Equation.

16 Practical Examination

References

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AEAS 177 Environmental Science and Disaster Management 3 (2+1)

Course outlines

Theory

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. 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-sports 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. 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 dies. 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.

Disaster Management: Natural Disasters and nature of natural disasters, their types and effects. Floods, drought, cyclone, tsunami, 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. Climate change- Impact of climate change and Climate resilient agricultural activities. 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.

Objectives

To make awareness about the importance of the environmental aspects of engineering systems and how effectively the environment can be protected from evil pollutants with thorough knowledge on the causes of pollution and issues of biodiversity, disaster management and environment protection acts.

Lecture

Theory

1 Environmental studies: Definition, scope and importance. Need for public awareness, People & Institutions in environment.

2 Natural resources: Renewable and non renewable resources; Forest resources – functions of forests. Use and over-exploitation, deforestation; causes and consequences of deforestation: case studies. Timber extraction - dams and their effects on forest and tribal people.

3 Water resources: Sources, use and over utilization of surface and ground waters; floods, drought, conflicts over water, dams – benefits and problems. Sustainable management of water. Mineral resources: Use and exploitation; Mining- environmental effects of extracting and using mineral resources, case studies.

4 Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

5 Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies

6 Land resources: Land use planning, 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.

7 Major Eco-systems: Concepts, characteristic features, structure and functions, Producers, consumers, decomposers, Energy flow, ecological succession, food chains, food webs, ecological pyramids. Types, characteristic features, structure and function of different

ecosystems viz. forest, grassland, desert, and aquatic eco-system (pond, stream, lakes, river, oceans and estuaries)

8 Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity, Biogeography 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

9 Biodiversity: Hot spots of Biodiversity, Threats to biodiversity, habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic spices of India.

10 Biodiversity: Conservation of biodiversity-in situ and ex situ. Methods of measuring biodiversity, Biodiversity Act, functions of National Biodiversity Authority.

11 Environmental pollution: Definition, causes, effects and control measures of air and water pollution, tolerable limits for toxic gases in air.

12 Environmental pollution: Causes, effects and control measures of soil pollution. Tolerable limits for heavy metals in soil.

13 Environmental pollution: Causes effects and control measures of marine, noise, thermal pollution and Nuclear hazards.

14 Solid Waste Management: Causes, effects and control measures of agricultural wastes, Urban and industrial wastes.

15 Environmental pollution: Role of individuals in prevention of pollution, case studies

16 Social issues of environment: unsustainable to sustainable developments, urban Problems related to energy

17 Water conservation, rain water harvesting and water shed management

18 Environmental ethics: Issues and possible solution

19 Climate change, sea level rise, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust dies

20 Waste lands reclamation activities, Consumerism and waste Products

21 The Environment Protection Act : The air (prevention and control of pollution) Act, The Water (prevention and control of pollution) Act, The Wildlife Protection Act and Forest Conservation Act

22 The Environment Protection Act: Issues involved in enforcement of environmental legislation, public awareness

23 Human population and the Environment: Population growth, variation among nations, population explosion and family welfare programmes

24 Environmental and human health: Woman and Child welfare, HIV/AIDS and Role of information technology on environment and human health

25 Disaster management :Natural Disasters and nature of the natural disasters, their types and effects- Floods, drought, cyclones, earthquake and tsunami

26 Disaster management: Landslides avalanches, volcanic eruptions, heat and cold waves

27 Disaster management: Climate change- Impact of climate change and Climate resilient agricultural activities

28 Man made disasters: Nuclear disasters, chemical disasters, biological disasters, building fire / coal fire /forest fire /oil fire

29 Man made disasters: Air pollution, water pollution, deforestation, industrial waste water pollution, road /rail/air /sea accidents

30 Disaster Management: Concept of disaster management, national disaster management frame work and financial arrangements

31 Disaster Management : Effect to mitigate natural disaster at national and global levels, International strategy for disaster reduction

32 Disaster Management: Role of NGO's, Community based organizations, media, Centre, state, district and local administration, armed forces, police and other organizations in disaster response

Practical

1 Visit to a local area to document environmental assets – rivers /forest

2 Visit to a local area to document environmental assets – grass land /hill

3 Visit to a local area to document environmental assets – Mountains

4 Visit to a local polluted site – Urban /Industrial

5 Visit to a local polluted site – Rural /Agricultural

6 Studies of Common Plants

7 Studies of Common Insects & Birds

8 Study of simple eco-systems – ponds, and rivers

9 Study of simple eco-systems –hill slopes

10 Study of expected impact of climate change on agricultural production

11 Study of expected impact of climate change on water resources

12 To study mitigation strategies, and economics of climate change

13 To study Natural disasters & Manmade disasters

14 Quantitative techniques for disaster management environmental impact assessment (ETA)

15 Disaster management policy and environmental modeling.

16 Practical Examination

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AEAS 178 Principles of Soil Science 3 (2+1)

Course outlines

Theory

Nature and origin of soil; soil forming rocks and minerals, their classification and composition, soil forming processes, classification of soils – soil taxonomy orders; 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; soil organic matter – its composition and decomposition, effect on soil fertility; soil reaction – acidic, saline and sodic soils; quality or irrigation water; essential plants nutrients – their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils. Use of saline and sodic water for crop production, Gypsum requirement for reclamation of sodic soils and neutralizing RSC; Liquid fertilizers and their solubility and compatibility.

Practical

Identification of rocks and minerals; Examination of soil profile in the field; Collection of Soil Sample; Determination of bulk density; particle density and porosity of soil; Determination of organic carbon of soil; Determination of Nitrogen, Determination of Phosphorus and Determination of Potassium; Identification of nutrient deficiency symptoms of crops in the field; Determination of gypsum requirement of sodic soils; Determination of water quality parameters.

Objectives

To impart knowledge on soil genesis, soil forming processes, structure, soil organic matter, soil chemical properties, etc which give a comprehensive idea to students how to design farm implements in relation to soils and also how to treat the soils for soil health and structure improvements, soil conservation, irrigation and drainage applications.

Lecture

Theory

1 Nature and origin of soil - soil definition, branches of soil science - difference between surface soil and sub surface soil.

2 Soil forming rocks - definition - classification of rocks - Igneous, Sedimentary and metamorphic rocks.

3 Minerals- definition -classification - Primary minerals – Secondary minerals; Silicate and non silicate minerals - Light and heavy minerals

4 Primary silicate minerals: Quartz: Feldspars - Micas- Pyroxengs- Amphiboles; Secondary minerals, micronutrient containing minerals

5 Soil formation- soil forming factors – active and passive soil factors and their role in soil formation.

6 Soil forming processes: Elluviation – Illuviation – Humification – Calcification- Laterization – Podzolization – Salinization – Alkalization and Gleization

7 Classification of soils – Soil taxonomy – Soil orders and their characteristics.

8 Soil physical properties – Soil structure – definition – classification based on type, class and grade – importance and management of soil structure.

9 Soil texture – definition- particle size distribution – textural classes – methods of determination of soil texture – importance of soil texture.

10 Bulk density and particle density –factors influencing and their importance. Soil consistency and importance

11 Porosity – types – calculation of porosity – importance of porosity –soil colour – colour components – significance of soil color.

12 Soil water – retention of soil moisture – soil moisture constants- Soil moisture tension – soil water potential

13 Soil water – laws governing water and vapour flow -saturated and un saturated flow - Darcy's law – Poiseuille's law

14 Soil water movement - Infiltration – Percolation –Lateral flow – Deep drainage

15 Soil air-composition- gaseous exchange – importance of soil air –management;

16 Soil temperature – influence on plant growth – factors influencing the soil temperature- Management of soil temperature.

17 Soil colloids- definition- inorganic and organic colloids- general properties- their composition- origin of charge on colloids.

18 Secondary clay minerals – properties of Kaolinite, Montmorillonite and Illite

19 Ion exchange in soil: Cation and Anion exchange – factors influencing ion exchange capacity of soils- importance of ion exchange- calculation of base saturation and exchange acidity and nutrient availability.

20 Soil organic matter- its composition and decomposition its importance effect on soil fertility.

21 Soil reaction, factors affecting pH of soil- influence of soil reaction on nutrient availability.

22 Acid soils- Formation – characteristics & nutrient availability- reclamation-Lime requirement

23 Saline soils – sodic/alkali soils – characteristics - formation and nutrient availability Reclamation- gypsum requirement for reclamation of sodic/alkali soils

24 Quality of irrigation water- classification based on EC, SAR, Cl, RSC and Boron content - Use of saline and sodic water for crop production

25 Essential plant nutrients- Arnon's criteria of essentiality- Nitrogen - Functions and deficiency symptoms in plants.

26 Phosphorus Potassium and calcium – Their functions and deficiency symptoms in plants.

27 Magnesium, Sulphur, Zinc and Iron - Their functions and deficiency symptoms in plants.

28 Manganese Copper, Boron and Molybdenum - Their functions and deficiency symptoms in plants.

29 Soil fertility and productivity – definition and concepts –factors influencing availability of nutrients – deficiency symptoms of nutrients.

30 Inorganic chemical fertilizers- classification- and their reactions in soils.

31 Liquid fertilizers- and their solubility and compatibility.

32 Beneficial soil micro organisms – Bio fertilizers and their use

Practical

1 Identification of rocks and minerals.

2 Observation of soil profile in the field and collection of soil sample

3 Determination of bulk density of soil.

4 Determination of particle density of soil.

5 Determination of organic carbon in soil.

6 Determination of nitrogen in soil.

7 Determination of phosphorus in soil.

8 Determination of potassium in soil.

9 Identification of nutrient deficiency symptoms of crops in field.

10 Determination of gypsum requirement of sodic or alkali soil.

11 Determination of pH and EC of irrigation water.

12 Determination of carbonates and bicarbonates in irrigation water.

13 Determination of chlorides in irrigation water.

14 Determination of calcium and magnesium content in irrigation water.

15 Determination of sodium and potassium content in irrigation water and computation of quality class, RSC and SAR of irrigation water.

16 Practical Examination

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AEAS 271 Principles of Horticultural Crops and Plant Protection 2 (1+1)

Course outlines

Theory

Scope of horticultural crops. Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties, criteria for site selection, layout and planting methods, nursery raising, commercial/hybrid varieties, sowing and planting times and methods, seed rate and seed treatment for vegetable crops, 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, garden tools, management of orchard, extraction and storage of vegetables seeds, major pests and diseases and their management in 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.

Objectives

To identification and description of important fruits, vegetables & flowers, study of different garden tools, seed viability and germination tests, preparation of nursery beds and seed sowing pruning and training in some important fruit crops, intercultural operations in vegetable crops etc.,

Lecture

Theory

1 Horticulture - definition of Horticulture - divisions of horticulture with suitable examples - scope and importance of horticulture - importance of horticulture in terms of economy, production and employment generation

2 Climate and soil requirements for horticultural crops - influence of environmental factors on horticultural crop production – temperature, humidity, wind, rainfall and solar radiation – influence of soil factors – soil type, pH

3 Improved, Commercial varieties and hybrids for Mango, Banana, Citrus, Grape, Papaya, Guava, Tomato, Chilli, Brinjal, Potato, Bhendi, Cucumber, Bitter gourd, Bottle gourd, Ridge gourd, Rose, Chrysanthemum, Marigold, Jasmine, Coconut, Cashew nut and Cocoa

4 Principles of orchard establishment – points to be kept in mind while selecting site for the establishment of orchards - principles and steps in orchard establishment - layout of orchards – systems of planting - square, rectangle, quincunx, hexagonal and contour systems of planting - their merits and demerits

5 Plant propagation - methods - sexual and asexual – asexual method of propagation — cuttings – definition of cutting – stem cuttings – leaf cuttings – layering - propagating structures - separation, division - separation – method of division – bulbs and corms

6 Grafting, budding - rootstock and scion selection – grafting methods – attached scion methods of grafting, simple or approach grafting, detached scion methods of grafting (side grafting, veneer grafting, epicotyl grafting, top working), budding – methods of budding, T-budding, inverted T-budding and patch budding

7 Seed rate - seed treatment and nursery raising for vegetable crops - Tomato, Chilli, Brinjal, Potato, Bhendi, Cucumber, Bittergourd, Bottlegourd, Ridgegourd

8 Plant growing structures – greenhouse, lath house, hotbed and cold frame

9 Principles and methods of training and pruning - definition of training, objectives and training, principles and methods of training of fruit crops -open centre, closed centre and modified leader systems their merits and demerits - definition of pruning, objectives of pruning, principles and methods of pruning of fruit crops

10 Critical stages for irrigation, fertilizers application, Different application methods to horticultural crops - broad casting, band placement, ring placement, foliar application, fertigation

11 Maturity indices of fruits and vegetables

12 Methods of harvesting – post harvest handling of horticultural produce - extraction of vegetable seeds of Tomato and Brinjal

13 Garden tools – pickaxe, kodali, spade, fork, furrow opener, shovel, garden rake, hand leveler, crow bar, trowel, axe, bill hook, budding knife, grafting knife, budding and grafting knife, pruning knife, prunning saw, hedge shear, tree pruner, lopping shear, grass shear, khurpi, hand cultivator, sickle, wheel barrow and maintenance of orchard

14 Pests and diseases and their management of Mango, Banana, Citrus, Grape and Papaya

15 Pests and diseases and their management of Tomato, Brinjal, Chilli, Bhendi, Cole crops and Cucurbitaceous crops

16 Pests and diseases and their management of Rose, Chrysanthemum, Marigold and Jasmine

Practical

1 Visit to orchard block in college farm

2 Identification and description of important fruits

3 Identification and description of important vegetables

4 Identification and description of important flowers

5 Study of different garden tools

6 Study of seed viability and germination tests

7 Preparation of nursery beds and seed sowing

8 Pruning and training in some important fruit crops

9 Intercultural operations in vegetable crops

10 Seed extraction techniques maturity indices of fruits

11 Irrigation methods

12 Maturity indices of fruits & vegetables

13 Identification of pest and diseases in fruits

14 Identification of pest and diseases in vegetables

15 Identification of pest and diseases in flower crops

16 Practical Examination

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AEAS 272 Entrepreneurship Development and Business Management 3 (2+1)

Course outlines

Theory

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, cash flow statement, analysis of financial statements, liquidity ratios, leverage ratios, coverage ratios, turnover ratios, profitability ratios. 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) and sensitivity analysis. Marketing management - marketing mix and market segmentation. Product Life Cycle (PLC) - meaning and stages in PLC, characteristics of PLC. Pricing – cost based and competition based pricing. Market promotion – advertising, personal selling, sales promotion and publicity and their meaning and merits & demerits. Agro-based industries - importance of agribusiness in Indian economy, assessing overall business environment in Indian economy. Globalization and the emerging business entrepreneurial environment, 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). Entrepreneurship Development (ED) - concept of entrepreneur and entrepreneurship, entrepreneurial and managerial characteristics, Entrepreneurial Development Programmes (EDP) - generation, incubation and commercialization of ideas and innovations. Motivation and entrepreneurship development. Managing an enterprise: Importance of planning, budgeting, monitoring, evaluation and follow-up forms of business ownership and selection of appropriate form of ownership. 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. 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 Strengths Weaknesses Opportunities and Threats (SWOT) analysis. Break-even analysis. Balance Sheet statements, profit & loss statements. Ratio analysis. Visit to agro-based industries. Study of agro-industries development corporation. Compounding and discounting techniques. Application of project appraisal techniques Undiscounted measures and Discounted Measures and it's sensitivity analysis. Formulation of project feasibility reports. Farm machinery project proposals as entrepreneur as individual and group. Presentation of project proposals.

Objectives

To impart knowldge on economic principles related to agriculture and to give the students an emphasis on farm business management, analysis of budgeting, credit analysis, market management and to train the students to become successful entrepreneurs and employers in their chosen field of agricultural engineering with management skills coagulated with motivation by way of considering the social and political systems and to perform SWOT analysis for the technological innovations

Lecture

Theory

1 Management – definitions and concepts. Management functions, wheel diagram

2 Planning - its importance, types of plans, goals, or objectives, strategies, policies, procedures, rules, programmes, characteristics of good plan, steps in planning.

3 Organizing – meaning, purpose, Staffing – definition, Staffing Process. Definitions and purpose of directing, motivation, ordering, leading, supervision, coordination, communication and control.

4 Capital – meaning and its importance and role in business, fixed capital and working capital - meaning, types of fixed and working capital, operating cycle and working capital importance.

5 Financial Management – importance of financial statements, balance sheet - meaning, assets and liabilities – meaning and classification, components and format of balance sheet

6 Profit and loss statement - meaning, components and format of profit and loss statement and cash flow statements

7 Ratio analysis - liquidity ratios, leverage ratios, coverage ratios, turnover ratios and profitability ratios

8 Project – meaning, definition, project cycle and it's phases, guidelines for preparation of project reports

9 Project appraisal and evaluation techniques – meaning of appraisal and evaluation, undiscounted measures and decision rules, PBP, ROR.

10 Discounted measures and decision rules – NPW, BCR, IRR, N/K ratio and sensitivity analysis.

11 Marketing management and marketing mix - meaning, 4Ps of marketing - product, price, place and promotion, their importance and characteristics in business development

12 Product life cycle - meaning and stages in PLC (Product Life Cycle), characteristics of PLC. Pricing – cost based and competition based pricing.

13 Market promotion – advertising, personal selling, sales promotion and publicity, their meaning and merits & demerits. Market segmentation-meaning and its importance.

14 Agro based industries – importance of agribusiness in Indian economy, need for agro-industries, institutional arrangements for the promotion of agro-based industries, assessing overall business environment in Indian economy.

15 Procedure to be followed to set up agro-based industries – constraints in establishing agro-based industries.

16 Globalization and the emerging business entrepreneurial environment and international trade. WTO - its genesis, objectives, functions and principles of multilateral trade.

17 WTO agreements, Agreements on Agriculture (AOA), domestic supply, market access, export subsidies. Agreement on Sanitary and Phyto-Sanitary (SPS) measures, provisions related to agreements in agricultural and food commodities.

18 TRIPS and Intellectual property rights and their implications to Indian agriculture. Patents, copy rights, trademarks, geographical indications, industrial designs, trade secrets, integrated circuits and plant varieties protection

19 Concept of entrepreneur and entrepreneurship – meaning, functions of an entrepreneur, types of entrepreneurs. Entrepreneurial and managerial characteristics, distinction between an entrepreneur and a manager.

20 Entrepreneurial Development Programmes (EDP) - meaning, objectives, course contents and curriculum development of EDPs, phases in EDPs.

21 Entrepreneurial Development and the role of generation, incubation and commercialization of ideas and innovations, motivation

22 EDPs in India and their problems

23 Managing an enterprise - importance of planning, budgeting, monitoring, evaluation and follow-up. Forms of business ownership and selection of appropriate form of ownership.

24 Managing competition- SWOT analysis in different areas of competition - production and product development, marketing, branding, financial and export markets.

25 Role of ED in economic development of a country - overview of Indian social, economic and political systems and their implications for decision making by individual entrepreneurs.

26 Corporate social responsibility (CSR) - meaning, its importance, forms of CSR, dimensions of CSR. Morals and ethics in enterprise management

27 Meaning of micro, small and medium enterprises. Micro, small and medium enterprises development act 2006 and its salient features and package for promotion of MSM enterprises.

28 Government and institutional support and schemes and incentives for promotion of MSM enterprises, Institutions like NSIC, SIDCO, SSIB, SSID, SISIs, DICs, Industrial estates, TCOs, SEZs, KVIC

29 Schemes - ATI, NMCP, SFURTI, ASPIRE, PCI, PMEGP, MA, CDP, CLCSC

30 Incentives and concessions related to tax, interest, subsidies, margin money, services and utilities and other incentives

31 Venture capital (VC), contract farming (CF) and joint ventures (JV), public private partnerships (PPP) - their meaning, importance in developing entrepreneurship and different programmes/ schemes under each one

32 Overview of agricultural engineering industry and characteristics of Indian farm machinery industry

Practical

1 Break-even analysis

2 Strengths Weaknesses Opportunities and Threats (SWOT) analysis.

3 Balance sheet statements

4 Profit and loss statements

5 Ratio analysis – I

6 Ratio analysis – II

7 Compounding and discounting techniques

8 Application of project appraisal techniques – I (Undiscounted measures)

9 Application of project appraisal techniques – II (Discounted Measures) and sensitivity analysis

10 Visit to agro-based industries – I

11 Visit to agro-based industries – II

12 Study of Agro-industries Development Corporation

13 Formulation of project feasibility reports – individual and group exercises.

14 Farm machinery project proposals as entrepreneur – individual and group exercises.

15 Presentation of project proposals

16 Practical Examination

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AEAS 273 Engineering Mathematics – III 3(2+1)

(Numerical Analysis and Statistical Methods)

Course outlines

Theory

Numerical analysis and Laplace transformation: finite difference, 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 formulae. Interpolation with unequal intervals. Newton's divided difference formula. Lagrange's interpolation formula. Numerical differentiations, numerical integrations, difference equations and their solutions, numerical solutions of ordinary differential equations by Picard's and Taylor's series. Fuller's and modified Fuller's methods. Runga-Kutta method. Laplace transformation and its applications to the solutions of ordinary and simultaneous differential equations. Testing of hypothesis - level of significance - degrees of freedom - statistical errors, large sample test (Z-test), small sample test, t-test (One tailed, two tailed and paired tests), testing of significance through variance (F-test), Chi - square test, contingency table, correlation and regression.

Practical

Tutorials on 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 and 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 with 2x2 and m x n. Calculation of correlation coefficient and its testing. Contingency table and F-test.

Objectives

To impart the knowledge of numerical methods, the mathematically based techniques that are utilized to solve engineering problems that are not easily solved or even impossible to solve by analytical means. The numerical techniques learned in this course enable students to work with mathematical models of technology and systems. Imparting the knowledge of statistical methods are extremely useful to make student to drawn inference about a population based on information from a sample by formulation and testing of hypothesis

Lecture

Theory

1 Numerical analysis: finite differences

2 Various difference operators and their relationships, factorial notation

3 Interpolation with equal intervals, Newton's forward interpolation formula

4 Newton's backward interpolation formula

5 Bessel's difference interpolation formula

6 Stirling's difference interpolation formula

7 Interpolation with unequal intervals, Newton's divided difference formula

8 Lagrange's interpolation formula

9 Numerical differentiation

10 Numerical integration

11 Difference equations and their solutions

12 Numerical solutions of ordinary differential equations by Picard's method

13 Numerical solutions of ordinary differential equations by Taylor's series method

14 Numerical solutions of ordinary differential equations by Euler's and modified Euler's methods

15 Numerical solutions of ordinary differential equations by Runga - Kutta method

16 Laplace transformation : definition of Laplace transformation, existence of Laplace transformation

17 Laplace transformation of elementary functions

18 Laplace transformation of derivative and integral of a function

19 Laplace transformation of a function multiplied by 't' and divided by 't'

20 Inverse Laplace transformation

21 Convolution theorem

22 Applications to the solutions of ordinary differential equations

23 Applications to the solutions of simultaneous differential equations

24 Statistics: Review of normal distribution, testing of hypothesis, level of significance, degrees of freedom and statistical errors

25 Testing of hypothesis for large sample using Z-test

26 Testing of hypothesis for small samples using t-test (one tailed and two tailed tests)

27 Testing of hypothesis for small sample using t-test (paired t-test)

28 Testing of significance through variance (F-test)

29 Testing of significance using Chi -square test

30 Testing of significance using Chi -square test for contingency table

31 Correlation analysis

32 Regression analysis

Practical

1 Problems on Newton's forward and backward interpolation formulae

2 Problems on Bessel's and Stirling's difference interpolation, Newton's divided difference formulae

3 Problems on numerical differentiation, numerical integration

4 Finding of solutions of difference equations

5 Problems on numerical solutions of ordinary differential equations by Picard's and Taylor's series methods

6 Problems on numerical solutions of ordinary differential equations by Modified Euler's and Runge- Kutta methods

7 Problems on Laplace transformations

8 Problems on inverse Laplace transformations

9 Problems on Laplace transformations and their application to solution of ordinary differential equation

10 Problems on one Sample, two sample Z-tests when population S.D. is known and unknown

11 Problems on one sample, two sample and paired t-test

12 Problems on Chi-square test

13 Problems on Chi-square test of 2x2 and m x n contingency table

14 Problems on calculation of correlation coefficient and its testing

15 Problems on regression analysis

16 Practical Examination

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6. Grewal B. S. 2013. Higher Engineering Mathematics. Khanna Publishers, Delhi.
7. Ramana B. V. 2006. Engineering Mathematics. Tata McGraw-Hill. New Delhi.
8. Gupta P. P. and Malik G. S. 2014. Calculus of Finite Differences and Numerical Analysis. Krishna Prakash Mandir, Meerut.

Student READY

Rural and Entrepreneurship Awareness Development Yojana

SRDY 281 Skill Development Training-I 5 (0+5)

Student has to undergo "Student READY Skill Development Training –I" for five weeks in the summer break after IV semester with a credit load of 0+5 credit hours.

SRDY 381 Skill Development Training-II 5 (0+5)

Student has to undergo "Student READY Skill Development Training –II" for five weeks in the summer break after VI semester with a credit load of 0+5 credit hours.

SRDY 481 Industrial Attachment/Internship 10 (0+10)

Student has to undergo In-plant training for a short period of time in relevant industry to gain the knowledge and experience of the work culture. In Plant training by reputed organization either MNC's or organized sectors provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements.

Student is attached to a industry for 10 weeks in VII semester with a credit load of 0+10 credit hours.

Technology and globalization are ushering an era of unprecedented change. The need and pressure for change and innovation is immense. To enrich the practical knowledge of the students, in-plant training shall be mandatory in the last semester for a period of up to 10 weeks. In this training, students will have to study a problem in industrial perspective and submit the reports to the University. Such in-plant trainings will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. In-Plant training is meant to correlate theory and actual practices in the industries. It is expected that sense of running an industry may be articulated in right way through this type of industrial attachment mode.

Objectives

- To expose the students to Industrial environment, which cannot be simulated in the University.
- To familiarize the students with various Materials, Machines, Processes, Products and their applications along with relevant aspects of shop management.
- To make the students understand the psychology of the workers, and approach to problems along with the practices followed at factory

- To make the students understand the scope, functions and job responsibility-ties invarious departments of an organization.
- Exposure to various aspects of entrepreneurship during the programme period.

SRDY 482 Experiential Learning On-campus 10 (0+10)

Experiential Learning helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. This is step forward for earning while learning concept. Experiential Learning is major step forward for high quality professional competence, practical work experience in real life situation to graduates, production oriented courses, production to consumption project working, facilitates producing Job providers rather than job seekers and entrepreneurial orientation.

Student has to undergo on campus Experiential Learning for 10 weeks in VII semester with a credit load of 0+10 credit hours.

Concept

The word 'experiential' essentially means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training, typically in group, by observation, study of theory or hypothesis, bring in innovation or some other transfer of skills or knowledge. Experiential Learning is a business curriculum-related endeavour which is interactive.

EL is for building (or reinforcing) skills in project development and execution, decision-making, individual and team coordination, approach to problem solving, accounting, marketing and resolving conflicts, etc. The programme has end to end approach. Carefully calibrated activities move participants to explore and discover their own potential. Both activities and facilitation play a critical role in enhancing team performance.

Objectives

To provide an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work.

The main objectives of EL are:

- To promote professional skills and knowledge through meaningful hands on experience.
- To build confidence and to work in project mode.
- To acquire enterprise management capabilities

Duration

The experiential learning programme will be offered for one semesterperiod in the final year. As the programme is enterprise oriented, students and faculty are expected to attend the activities of the enterprise even on institutional holidays with total commitment, and without any time limit or restriction of working hours for ELP. The Experiential Learning Programme shall be run for full year by making two groups and rotating activities of the final year in two groups.

Attendance

The minimum attendance required for this programme is 85%. The attendance of a student will be maintained at the EL unit. The attendance particulars shall be communicated to the Chief Executive Officer (Associate Dean) by the Manager of the EL unit every week. The students will be eligible for the final evaluation of EL only when the attendance requirement is met with. Any student in the event of recording shortage of attendance has to re-register the EL when offered next by paying the assigned fee.

Students' Eligibility

To get the eligibility for registering the EL programme, the students should have completed all the courses successfully. No student should be allowed to take up the EL programme with backlog/repeat courses. The assignment/allotment of the EL programme shall be based on merit of the student at the end of 5th Semester. A separate certificate should be issued to the students after successful completion of EL course. Allotment of EL programmes amongst students to different modules should be done strictly on the basis of merit at the end of fifth semester. In this work experience, students will know exact problems of farming & suggest appropriate technology and finally useful in enhancing productivity and profitability at farmers end.

It was suggested that all Agricultural Engineering colleges should have Experiential Learning Units and in case these units are lying useless, outsourcing of these units, could be good option to generate money from them throughout the year.

SRDY 483 Educational Tour 2 (0+2)

Student has to undergo “Student READY Educational Tour” to various industries within or outside state of the university and submission of report on educational tour carrying a weightage of 2 (0+2) credit hours.

SRDY 484 Project Work and Report Writing 10 (0+10)

Student Project is essential for students interested in higher education. Through this component, they will know how to identify research problem, experimental set up and writing report etc.

Student has to complete "Student READY –Project" with a credit load of 0+3 credit hours to undertake investigation of selected problems of special interests in Food Processing Technology to individual student. The work includes library work, field or laboratory research, recording data, analyzing data and writing of report, etc.

Student will select relevant or interested area of specialization such as process &Food Engineering, Farm Machinery Power Engineering, Soil and Water Conservation Engineering, Agro – energy etc., The student will prepare a research project plan and it will be presented infront of committee appointed by the Dean of the respective college. Also, for each student, one advisor will be provided, who will guide the student in completion of proposed research plan. A total of 3 credit hours will be allotted for preparation of the project and its presentation as a seminar. This exercise will prepare students interested in higher education. They will be exposed with identifications of problems in experimental setup and project preparation.

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Elective Courses

FMPE 411 Mechanics of Tillage and Traction 3 (2+1)

Course outlines

Theory

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship, design of tillage tools, principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics and traction prediction equation. Performance of tillage tools. 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.

Objectives

To enable the students to understand the mechanics of tillage tools in relation with soil and designing the soil engaging elements. To know the design of soil engaging elements, measurement of shear, compressive, tensile strength of soil and also getting knowledge on Tread design, traction and transport devices.

Lecture

Theory

1 Introduction - Mechanics of tillage tools - Relation of soil to tillage tools - Principals for developing a machine

2 Engineering properties of soil- Stress in soil - Strain in soil - Stress Strain relations – Soil strength - Stress distribution - Strain distribution

3 Engineering properties- Yield in soil-Compression-Tension-Plastic flow-Rigid body soil movement-Momentum-Friction-Adhesion

4 Introduction –Design of tillage tools – Design equations- Relation between soil and tool factors in design- Force Analysis- principals of soil cutting

5 Introduction –Design of tillage tools – Design equations- Relation between soil and tool factors in design- Force Analysis- principals of soil cutting

6 Theory of elasticity equations in two dimensional analysis in orthogonal co-ordinates

7	Shear stress on rupture surface- Theory of elasticity equations in two dimensional analysis in orthogonal co-ordinates
8	Application of dimensional analysis in soil dynamics- Soil properties in relation to tillage- Traction prediction Equation
9	Application of dimensional analysis in soil dynamics- Soil properties in relation to tillage- Traction prediction Equation
10	Measurement of shear, compressive and tensile strength of soil
11	Measurement of shear, compressive and tensile strength of soil
12	Mean stress determination – friction, adhesion and abrasion
13	Performance of tillage tools – Introduction-soil conditions-Break up- Segregation-mixing-Handling plant residue- Separating
14	Performance of tillage tools – Introduction-soil conditions-Break up- Segregation-mixing-Handling plant residue- Separating
15	Performance of tillage tools – Introduction-soil conditions-Break up- Segregation-mixing-Handling plant residue- Separating
16	Introduction to traction and mechanics of traction devices-Non rolling traction devices-Rolling traction devices- Transport devices
17	Introduction to traction and mechanics of traction devices-Traction model and traction improvement-Non rolling traction devices-Rolling traction devices - Transport devices
18	Introduction to traction and mechanics of traction devices-Traction model and traction improvement-Non rolling traction devices-Rolling traction devices- Transport devices
19	Traction performance equations-Traction prediction from dimensional analysis
20	Traction performance equations-Traction prediction from dimensional analysis
21	Performance of Four wheel, tandem, and dual tires- Tire size-Load-air pressure relationship
22	Performance of Four wheel, tandem, and dual tires- Tire size-Load-air pressure relationship
23	Tread design - tire lug geometry - effect of lug spacing – Traction improvement Tracks-tire testing
24	Tread design - effect of lug spacing – Traction improvement – Tracks - tire testing
25	Tread design-effect of lug spacing – Traction improvement - Tracks- tire testing
26	Soil properties in relation to soil wheel interaction – properties governing slip- shrinkage and compaction
27	Soil properties in relation to soil wheel interaction – properties governing slip- shrinkage and compaction
28	Design of traction and transport devices – Transport devices- Driven wheels-tracks – auxiliary devices- operational control of design factors-Off road traction and mobility

29 Soil compaction – Introduction-compaction behavior equations -compaction in tillage and traction- effect of plant growth

30 Soil compaction – Introduction-compaction behavior equations -compaction in tillage and traction - effect of plant growth

31 Variability and geo statistic, application of GIS in soil dynamics

32 Variability and geo statistic, application of GIS in soil dynamics

Practical

1 Measurement of static and dynamic soil parameters related to tillage

2 Measurement of soil parameters related to puddling and floatation

3 Measurement of draft for passive rotary and oscillating tools

4 Measurement of slip and sinkage under dry and wet soil conditions

5 Measurement of load and fuel consumption for different farm operations

6 Economics of weight transfer and tractor loading including placement and traction aids

7 Studies on tyres, tracks and treads under different conditions

8 Studies on compaction and number of operations

9 Problems on mechanics of tillage tools

10 Problems on design of traction devices

11 Problems on design of transport devices

12 Problems on soil dynamics in soil machine systems

13 Problems on determination of stress and strain

14 Study of the techniques for evaluating soil structure

15 Application of GIS in soil dynamics

16 Practical Examination

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1. William R. Gill, Glen E. Vanden Berg. 1968. Soil dynamics in tillage and traction Agricultural Research Service, United States Department of Agriculture, USA.
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FMPE 412 Farm Machinery Design and Production 3 (2+1)

Course outlines

Theory

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

Objectives

To enable the students to know the development of different agricultural machinery and the material used for manufacturing the machinery parts. To understand the different processes and machinery involved in manufacturing the agricultural machines and to acquire knowledge on CNC tooling, turning tools, milling tools, drilling tools, finishing tools. To know the industrial lay out, planning, organization, administration and management.

Lecture

Theory

1 Introduction to design parameters of agricultural machines and procedure

2 Characteristics of farm machinery design

3 Characteristics of farm machinery design

4 Research and development aspects of farm machinery

5 Research and development aspects of farm machinery

6 Design of standard power transmission components used in agricultural machines-mechanical and hydraulic units

7 Design of standard power transmission components used in agricultural machines-mechanical and hydraulic units

8 Design of standard power transmission components used in agricultural machines-mechanical and hydraulic units

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 Critical appraisal in production of agricultural machinery

13 Critical appraisal in production of agricultural machinery

14 Advances in material used for agricultural machinery

15 Advances in material used for agricultural machinery

16 Cutting tools including CNC tools and finishing tools

17 Cutting tools including CNC tools and finishing tools

18 Cutting tools including CNC tools and finishing tools

19 Advanced manufacturing techniques including power metallurgy, EDM (Electro-Discharge Machining)

20 Advanced manufacturing techniques including power metallurgy, EDM (Electro-Discharge Machining)

21 Heat treatment of steels including pack carburizing, shot piping process

22 Heat treatment of steels including pack carburizing, shot piping process

23 Limits, fits and tolerances, jigs and fixtures

24 Limits, fits and tolerances, jigs and fixtures

25 Industrial lay-out planning – Space planning, activity centers, factors for consideration in space planning, determination of space requirements

26 Industrial lay-out planning – area allocation, factors considered for area allocation, plant layout, factors affecting layout, layout of services, types of layout problems, methods of layout

27 Quality production management

28 Reliability

29 Economics of process selection

30 Economics of process selection

31 Familiarization with project report

32 Familiarization with project report

Practical

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

References

1. A. C., Tiwari, P. S., Suresh Narang and Mehta, C. R. 2004. Data Book for Agricultural Machine Design Varshney, Central Institute of Agricultural Engineering, Nabi Bagh, Berasia Road, Bhopal.
2. Adinath, M. and Gupta, A. B. 2012. Manufacturing Technology. New Heights Publishers, Karol Bagh. New Delhi.
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5. Richey, C. B. 1961. Agricultural Engineer's Handbook. McGraw-Hill Publisher. New York.

FMPE 413 Human Engineering and Safety 3 (2+1)

Course outlines

Theory

Human factors in system development – concept of systems. basic processes in system development, performance reliability, human performance. Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications.

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. Anthropometry - arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, 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

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.

Objectives

To enable the students to study of human relation with environmental factors, study of anthropometry, study of safety gadgets for spraying, chaff cutting and tractor and trailer operator.

Theory

1 Human factors in system development – concept of systems

2 Human factors in system development – concept of systems

3 Basic processes in system development

4 Performance reliability

5 Human performance

6 Information input process

7 Visual displays

8 Major types and use of displays

9 Auditory and factual displays

10 Speech communications

11 Biomechanics of motion

12 Types of movements

13 Range of movements

14 Strength and endurance

15 Speed and accuracy

16 Human control of systems

17 Human motor activities
18 Human controls, tools
19 Human related devices
20 Anthropometry: arrangement and utilization of work space
21 Anthropometry: arrangement and utilization of work space
22 Atmospheric conditions
23 Atmospheric conditions
24 Heat exchange process and performance
25 Air pollution
26 Dangerous machine (Regulation) act
27 Rehabilitation and compensation to accident victims
28 Safety gadgets for spraying
29 Safety gadgets for threshing
30 Safety gadgets for Chaff cutting
31 Safety Gadgets for tractor & trailer operation etc
32 Safety Gadgets for tractor & trailer operation etc

Practical

1 Calibration of the subject in the laboratory using bi-cycle ergo-meter
2 Calibration of the subject in the laboratory using bi-cycle ergo-meter
3 Study and calibration of the subject in the laboratory using mechanical treadmill
4 Study and calibration of the subject in the laboratory using mechanical treadmill
5 Use of respiration gas meter from human energy point of view
6 Use of respiration gas meter from human energy point of view
7 Use of Heart Rate Monitor
8 Study of general fatigue of the subject using Blink ratio method
9 Familiarization with electro-myograph equipment
10 Familiarization of anthropometric measurements of a selected subjects
11 Optimum work space layout and locations of controls for different tractors
12 Familiarization with the noise and vibration equipment
13 Familiarization with the noise and vibration equipment
14 Familiarization with safety gadgets for various farm machines
15 Familiarization with safety gadgets for various farm machines
16 Practical Examination

References

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7. Yadav R, Tewari V. K. 1998. Tractor operator workplace design-a review. Journal of Terra mechanics 35: 41-53.

FMPE 414 **Tractor Design and Testing** **3 (2+1)**

Course outlines

Theory

Procedure for design and development of agricultural tractor, classification, selection. Study of parameters for balanced design of tractor for stability & weight distribution, traction theory, hydraulic lift and hitch system design. Complete drive train, transmission. Design of mechanical power transmission in agricultural tractors: single disc, multi disc and cone clutches. Rolling friction and anti-friction bearings. Design of Ackerman Steering and tractor hydraulic steering. Study of special design features of tractor engines and their selection viz. cylinder, piston, piston pin, crankshaft, etc. Design of seat and controls of an agricultural tractor. Tractor Testing.

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.

Objectives

To enable the students to know the development of agricultural tractors and different operations performed by the tractors. To know the different trouble shootings and remedies, design of different parts. To get knowledge on different tests performed on tractors.

Lecture

Theory

1 Introduction – Design and Development of agricultural tractor- Classification and selection of tractors - Parameters to be considered for design of tractors and trends in Tractor

2 Introduction – Design and Development of agricultural tractor- Classification and selection of tractors - Parameters to be considers for design of tractors and trends in Tractor

3 Study of parameters for balanced design of tractor for stability- weight distribution- weight transfer in tractors –Location of centre of gravity

4 Study of parameters for balanced design of tractor for stability- weight distribution- weight transfer in tractors –Location of centre of gravity

5 Traction theory, hydraulic lift and hitch system design

6 Traction theory, hydraulic lift and hitch system design

7 Complete drive train, transmission types, friction brakes and clutches

8 Bevel gears, gear design

9 Differentials and transmission shafts

10 Design of single disc, multi disc and cone clutches

11 Design of single disc, multi disc and cone clutches

12 Design of Rolling friction and anti-friction bearings

13 Design of Rolling friction and anti-friction bearings

12 Steering system-Qualities of steering system-Steering geometry - Design of Ackerman Steering

13 Working of hydraulic or power steering-maintenance – Steering and front end trouble shooting

14 Working of hydraulic or power steering-maintenance – Steering and front end trouble shooting

15 Study of special design features of tractor engines and their selection

16 Study of special design features of tractor engines and their selection

17 Design of cylinder, piston, piston pin, crankshaft

18 Design of cylinder, piston, piston pin, crankshaft

19 Design of cylinder, piston, piston pin, crankshaft

20 Design of cylinder, piston, piston pin, crankshaft

21 Design of seat and controls of an agricultural tractor

22 Design of seat and controls of an agricultural tractor

23 Design of seat and controls of an agricultural tractor

24 Tractor hydraulic systems- Principle of hydraulics- working of hydraulic system - Components of hydraulic circuits & different valves

25 Tractor hydraulic systems - Principle of hydraulics - working of hydraulic system - Components of hydraulic circuits - different valves in hydraulic system

26 Hydraulic controls-Position control system - Draft control system-Maintenance and repair of hydraulic system

27 Hydraulic controls-Position control system- Draft control system-Maintenance and repair of hydraulic system

28 Tractor Engines-types - special design features – Technical terms- specifications

29 Tractor Testing – Introduction -Testing and evaluation system in India - Test facility in India

30 Types of tests - Lab Test - Field Test - Power test – Different types of dynamometers- Engine performance curves

31 Types of tests - Lab Test - Field Test - Power test – Different types of dynamometers- Engine performance curves

32 Types of tests - Lab Test - Field Test - Power test – Different types of dynamometers- Engine performance curves

Practical

1 Design problem of tractor clutch – (Single/ Multiple disc clutch)

2 Design problem on spur gears

3 Design problem of bevel gears

4 Design problem of helical gears

5 Design of gear box(synchromesh/constant mesh)

6 Design of variable speed constant mesh drive

7 Selection of tractor tires – Problem solving

8 Problem on design of governor

9 Problem related to selection of hydraulic pump

10 Engine testing as per BIS code – various test

11 Drawbar performance in the lab

12 PTO test and measure the tractor power in the lab/field

13 Determining the turning space, turning radius and brake test, hydraulic pump performance test and air cleaner and noise measurement test.

14 Design of seat and controls of an agricultural tractor

15 Visit to tractor testing center/industry

16 Practical examination

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2. Raymond N, Yong E. A. and Nicolas S. 1984. Vehicle Traction Mechanics, Elsevier Scitific Publications, USA.
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FMPE 415 Hydraulic Drives and Controls 3 (2+1)

Course outlines

Theory

Hydraulic Basics: Pascal's Law, flow, energy, work, and power. hydraulic systems, color coding, reservoirs, strainers and filters, filtering material and elements. Accumulators, pressure gauges and volume meters, hydraulic circuit, fittings and connectors. Pumps, pump classifications, operation, performance, displacement, design of gear pumps, vane pumps, piston pumps. 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 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.

Objectives

To train the students in usage and operation of hydraulic and pneumatic controls required for automation of different engineering interventions in agriculture.

Lecture

Theory

1 Hydraulic Basics

2 Pascal's Law, Flow, Energy, Work, and Power

3 Hydraulic Systems

4 Colour Coding

5 Reservoirs

6 Strainers and Filters, Filtering Material and Elements.

7 Hydraulic Accumulators

8 Pressure Gauges and Volume Meters

9 Hydraulic Circuit, Fittings and Connectors

10 Pumps, Pump Classifications, operation and performance

11 Design of Gear Pumps, Vane Pumps, Piston Pumps

12 Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance

13 Hydraulic Motors-Size Specification and Operation

14 Hydraulic cylinders-size and specifications, operation

15 Hydraulic Valves:, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves

16 Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves

17 Hydraulic hoses, Sizes & specifications of Hoses

18 Hydraulic Circuit Diagrams and Troubleshooting

19 United States of American Standards Institute USASI Graphical Symbols, ADDC

20 Tractor hydraulics & nudging system

21 Pneumatics: Air services, logic units, Fail safe and safety systems

22 Pneumatic circuits and applications-introduction, pneumatic circuit design considerations, air pressure losses in pipe lines, economic cost of energy losses, basic pneumatic circuit analysis using metric system

23 Application of Hydraulics and Pneumatics drives in agricultural machinery

24 Basics of Programmable logic controls (PLC), Advantages, Capabilities of PLC, Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules, configuring a PLC, PLC wiring

25 Applications of PLC: Case studies of Machine automation, Process automation, Selection parameters for PLC. Introduction to Programmable Automation Controller

26 Robotics: Introduction, brief history, types, classification and usage, Science and Technology of robots

27 Robot drive mechanisms: hydraulic – electric – servomotor- stepper motor - pneumatic drives

28 Tractor hydraulic system

29 Operation and maintenance of tractor hydraulic system

30 Trouble shooting of tractor hydraulic system

31 Hydraulics of dozing & Hoeing equipment

32 Hydraulics of tractor attached equipment

Practical

1 Study of hydraulic pumps

2 Study of hydraulic actuators

3 Study of hydraulic motors

4 Study of hydraulic valves

5 Study of Hydraulic circuits

6 Building simple hydraulic circuits

7 Study of colour codes and circuits

8 Studying Hydraulic system of tractor

9 Operation and maintenance of tractor hydraulic system

10 Repair and maintenance of tractor hydraulic system

11 Operation and maintenance of tractor pneumatic devices like tyre

12 Operation and maintenance of hydraulic system of Dozer

13 Operation and maintenance of hydraulic system of hoe

14 Operation and maintenance of hydraulic system of tractor attached equipment

15 Use of hydraulics and pneumatics for robotics

16 Practical Examination

References

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FMPE 416 Precision Agriculture and System Management 3 (2+1)

Course outlines

Theory

Precision Agriculture – need and functional requirements. Familiarization with issues relating to natural resources. 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. Introduction to GIS based precision agriculture and its applications. Introduction to sensors and application of sensors for data generation. Database management. 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.

Objectives

To acquire the knowledge by the students regarding precision agriculture including farm machinery equipment and natural resources, introduction to GIS bases precision agriculture, sensors and data management, system concept and application of PERT and CPM for machinery system management.

Lecture

Theory

1 Precision Agriculture – need and functional requirements

2 Precision Agriculture – need and functional requirements

3 Familiarization with issues relating to natural resources

4 Familiarization with issues relating to natural resources

5 Familiarization with equipment for precision agriculture including sowing and planting machines

6 Familiarization with equipment for precision agriculture including sowing machines

7 Familiarization with equipment for precision agriculture including sowing machines
8 Familiarization with equipment for precision agriculture including planting machines
9 Familiarization with equipment for precision agriculture including planting machines
10 Familiarization with equipment for precision agriculture including power sprayers, land clearing machines(including laser guided land leveler)
11 Familiarization with equipment for precision agriculture including power sprayers, land clearing machines
12 Familiarization with equipment for precision agriculture including power sprayers, land clearing machines
13 Familiarization with equipment for precision agriculture including straw-chopper, straw-balers, grain combines, etc.
14 Familiarization with equipment for precision agriculture including straw-chopper, straw-balers, grain combines, etc.
15 Familiarization with equipment for precision agriculture including straw-chopper, straw-balers, grain combines, etc.
16 Introduction to GIS based precision agriculture and its applications
17 Introduction to GIS based precision agriculture and its applications
18 Introduction to GIS based precision agriculture and its applications
19 Introduction to sensors and application of sensors for data generation
20 Introduction to sensors and application of sensors for data generation
21 Database management
22 Database management
23 System concept: System approach in farm machinery management
24 System concept: System approach in farm machinery management
25 Problems on machinery selection
26 Problems on machinery selection
27 Problems on maintenance and scheduling of operations
28 Problems on maintenance and scheduling of operations
29 Application to PERT for machinery system management
30 Application to PERT for machinery system management
31 Application to CPM for machinery system management
32 Application to CPM for machinery system management

Practical

1 Familiarization with precision agriculture problems and issues
2 Familiarization with precision agriculture problems and issues
3 Familiarization with various machines for resource conservation

4 Familiarization with various machines for resource conservation
5 Solving problems related to various capacities, pattern efficiency, system limitation
6 Solving problems related to various capacities, pattern efficiency, system limitation
7 Solving problems related to various capacities, pattern efficiency, system limitation
8 Problems related to cost analysis
9 Problems related to cost analysis
10 Problems related to inflation
11 Problems related to inflation
12 problems related to selection of equipment
13 problems related to selection of equipment
14 problems related to replacement, break-even analysis, time value of money
15 problems related to replacement, break-even analysis, time value of money
16 Practical Examination

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FMPE 417 Mechatronics 3 (2+1)

Course outlines

Theory

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. 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. 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. Robotics, Robot components, robot classification and specification, drive mechanisms, mechanical transmission method, languages, 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. Temperature measurement using Semiconductor temperature sensor. Pressure & Displacement measurement by LVDT. Torque measurement by Strain Gauge Transducers. 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. Study of different types of robots based on configuration and application. Study of different type of links and joints used in robots. Study of components of robots with drive system and end effectors. Determination of maximum and minimum position of links. Robot programming exercises

Objectives

To make the students familiar with the basic concepts of mechatronics required for application of sensors, hydraulic systems, and Robotics in agriculture and allied sectors.

Lecture

Theory

1 Introduction: Definition of mechatronics, Mechatronics in manufacturing, Products and design. Comparison between Traditional and Mechatronics approach

2 Review of fundamentals of electronics. Data conversion devices, sensors, micro sensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs

3 Brief overview of measurement systems, classification, characteristics and calibration of different sensors

4 Transducer: Definition, classification (active, passive, primary, secondary, mechanical, electrical, analog, digital, Photo-electrical, flow & optical transducers), selection criteria, sources of error for parameter under measurement, transducer specifications, test condition & operating conditions

5 Measurement of displacement, position, motion, force, torque, strain gauge, pressure flow, temperature sensor sensors & Proximity sensor

6 Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems

7 Actuators, definition, example, types, selection. Pneumatic actuator. Electro-pneumatic actuator

8 Hydraulic actuator, control valves, valve sizing valve selection

9 Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems

10 Electrical actuating systems: solid-state switches, solenoids, voice coil; electric motors; DC motors, AC motors, single phase motor; 3-phase motor; induction motor; synchronous motor; stepper motors

11 Piezoelectric actuator: characterization, operation, and fabrication; shape memory alloys

12 Basic elements of Digital signal processing- concept of frequesnct in Analog and Digital signals- measurement systems-pulse modulations-data presentation system

13 System modelling & control, Mathematical Models, Modelling Dynamic Systems, Transfer Functions, Control Models

14 Evolution of microprocessors and microcontrollers, memory devices, number system, architecture, interrupts instruction set and computer interfacing

15 Micro-controllers, Application of Microcontrollers

16 History and developments in industrial automation. Vertical integration of industrial automation, Control elements in industrial automation, PLC introduction

17 Basics of PLC, Advantages, Capabilities of PLC, Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules, configuring a PLC, PLC wiring

18 Installation and maintenance procedures for PLC - Troubleshooting of PLC, PLC Networking, Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet

19 Applications of PLC: Case studies of Machine automation, Process automation, Selection parameters for PLC. Introduction to Programmable Automation Controller

20 Description of PID controllers. CNC machines and part programming

21 Robotics: Introduction -- brief history, types, classification and usage, Science and Technology of robots

22 Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations - Transformation Arithmetic - D-H Representation - Forward and inverse Kinematics Of Six Degree of Freedom Robot Arm – Robot Arm dynamics

23 Robot drive mechanisms: hydraulic – electric – servomotor- stepper motor - pneumatic drives

24 Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws

25 Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion – straight line motion

26 Robot languages -.computer control and Robot software

27 Robot applications in manufacturing, Material transfer and machine loading/unloading

28 Robotics applications in Processing operations like Welding & painting, Assembly operations

29 Robotics applications in Inspection automation

30 Robotics applications in farm operations

31 Robotics applications in operation of off road vehicles

32 Future applications of robotics in agriculture

Practical

1 Selection of sensor for a particular application from Catalogue/Internet

2 Temperature measurement using Semiconductor temperature sensor

3 Pressure & Displacement measurement by Linear Variable Displacement Transducers (LVDT)

4 Torque measurement by Strain Gauge Transducers

5 Measurement of speed using Magnetic Pick-Up Proximity Sensor

6 Study of load cell. (To study the load cell behavior for tensile & compressive load)

7 Design a mechatronics product/system and incorporate application of mechatronics for enhancing product values

8 Study the hardware and software of mechatronics kit

9 Study the movement of actuating cylinders and sensors

10 Running a motor with PLC and conveyor with computer

11 Study of different types of robots based on configuration and application

12 Study of different type of links and joints used in robots

13 Study of components of robots with drive system and end effectors

14 Determination of maximum and minimum position of links

15 Robot programming exercises

16 Practical Examination

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PFEN 421 **Food Quality and Control** **3 (2+1)**

Course outlines

Theory

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

Objectives

To enable the students to understand the basics of food science, different quality parameters of food, laws and regulations governing food quality and to encourage the students to start their own entrepreneurship in food processing sector.

Lecture

Theory

1 Basics of Food Science and Food Analysis

2 Concept, objectives and need of food quality

3 Measurement of color, flavor, consistency, viscosity, texture and their relationship with food quality and composition

4 Measurement of color, flavor, consistency, viscosity, texture and their relationship with food quality and composition

5 Measurement of color, flavor, consistency, viscosity, texture and their relationship with food quality and composition

6 Sampling; purpose, sampling techniques

7 Sampling procedures for liquid, powdered and granular materials

8 Quality control, Quality control tools, Statistical quality control

9 Quality control, Quality control tools, Statistical quality control

10 Sensory evaluation methods, panel selection methods, Interpretation of sensory results

11 Sensory evaluation methods, panel selection methods, Interpretation of sensory results

12 Instrumental method for testing quality

13 Instrumental method for testing quality

14 Food adulteration and food safety

15 Food adulteration and food safety

16 TQM and TQC, consumer preferences and acceptance

17 Food Safety Management Systems; GAP

18 Food Safety Management Systems; GHP

19 Food Safety Management Systems; GMP

20 Hazards and HACCP (Hazard analysis and critical control point)

21 Sanitation in food industry (SSOP)

22 Food Laws and Regulations in India, FSSAI

23 Food Laws and Regulations in India, FSSAI

24 Food grades and standards BIS, AGMARK, PFA, FPO

25 Food grades and standards BIS, AGMARK, PFA, FPO

26 Food grades and standards BIS, AGMARK, PFA, FPO

27 ISO 9000, 22000 Series

28 CAC (Codex Alimentarious Commission)

29 Traceability and Quality Assurance system in a process plant

30 Traceability and Quality Assurance system in a process plant

31 Bio-safety

32 Bioterrorism

Practical

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

2 Detection of adulteration and examination of ghee for various standards of AGMARK & BIS standards

3 Detection of adulteration and examination of spices for AGMARK and BIS standards

4 Detection of adulteration and examination of spices for AGMARK and BIS standards

5 Detection of adulteration and examination of milk and milk products for BIS standards

6 Detection of adulteration and examination of milk and milk products for BIS standards

7 Detection of adulteration and examination of fruit products such as jams, jellys, marmalades for FPO specification

8 Detection of adulteration and examination of fruit products such as jams, jellys, marmalades for FPO specification

9 Visit to quality control laboratory

10 Case study of statistical process control in food processing industry

11 Study of registration process and licensing procedure under FSSAI

12 Study of registration process and licensing procedure under FSSAI

13 Study of sampling techniques from food processing establishments

14 Visit to food processing laboratory and study of records and reports maintained by food processing laboratory

15 Visit to food processing laboratory and study of records and reports maintained by food processing laboratory

16 Practical Examination

References

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PFEN 422 Food Plant Design and Management 3 (2+1)

Course outlines

Theory

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. 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, 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, 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.

Objectives

To provide knowledge on layout and design of food plants, development of process flow diagrams for different food materials, food marketing and management, entrepreneurship development policies and licensing procedures, etc.

Lecture

Theory

1 Food plant location, selection criteria
2 Selection of processes, plant capacity
3 Requirements of plant building and its components
4 Project design, flow diagrams
5 Project design, flow diagrams
6 Selection of equipment
7 Process and controls
8 Objectives and principles of food plant layout
9 Salient features of processing plants for cereals, pulses, oilseeds
10 Salient features of processing plants for horticultural crops
11 Salient features of processing plants for vegetable crops
12 Salient features of processing plants for poultry, fish and meat products
13 Salient features of processing plants for milk and milk products
14 Introduction to Finance
15 Food Product Marketing
16 Food Business Analysis
17 Food business strategic planning
18 Introduction to Marketing
19 Food Marketing Management
20 Supply chain management for retail food products
21 Entrepreneurship development in food industry
22 Entrepreneurship development in food industry

23 SWOT analysis, generation, incubation

24 Commercialization of ideas and innovations

25 New product development process

26 New product development process

27 Government schemes and incentive for promotion of entrepreneurship

28 Govt. policy on small and medium scale food processing enterprise

29 Export and import policies relevant to food processing sector

30 Procedure of obtaining license and registration under FSSAI

31 Cost analysis and preparation of feasibility report

32 Cost analysis and preparation of feasibility report

Practical

1 Preparation of project report

2 Preparation of feasibility report, Salient features

3 Layout of pre processing house, Salient features

4 Layout of pre processing house, Salient features

5 Layout of pre processing house, Salient features

6 Layout of Milk and Milk product plants

7 Layout of Milk and Milk product plants

8 Evaluation of given layout, Salient features

9 Design and layout of modern rice mill, Salient features

10 Design and layout of modern rice mill, Salient features

11 Design and layout of Bakery and related product plant

12 Study of different types of records relating to production of a food plant

13 Study of different types of records relating to finance of a food plant

14 Study of different types of records relating to marketing of a food business

15 Brain storming and SWOT analysis to start a food processing business

16 Practical Examination

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PFEN 423 Food Packaging Technology 3 (2+1)

Course outlines

Theory

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, 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, 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, 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.

Objectives

To provide knowledge on spoilage of food materials, various packaging systems, different packaging materials and their properties, testing of packaging materials and packaging equipments. To enable the students to acquire skills and to understand the packaging technology.

Lecture

Theory

1 Factors affecting shelf life of food material during storage

2 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

6 Frame work of packaging strategy, environmental considerations

7 Packaging systems, types: flexible and rigid; retail and bulk

8 Levels of packaging; special solutions

9 Packaging machines

10 Technical packaging systems and data management packaging systems

11 Different types of packaging materials, their key properties and applications

12 Metal cans, manufacture of two piece and three piece cans

13 Plastic packaging, different types of polymers used in food packaging and their barrier properties

14 Manufacture of plastic packaging materials, profile extrusion, blown film/ sheet extrusion,

15 Manufacture of plastic packaging materials by blow molding, extrusion blow molding

16 Manufacture of plastic packaging materials by injection blow molding, stretch blow molding, injection molding

17 Glass containers, types of glass used in food packaging,

18 Manufacture of glass and glass containers, closures for glass container

19 Paper and paper board packaging, paper and paper board manufacture process,

20 Modification of barrier properties and characteristics of paper/ boards.

21 Relative advantages and disadvantages of different packaging materials, effect of these materials on packed commodities

22 Nutritional labelling on packages, CAS and MAP, packaging,

23 Shrink and cling, vacuum and gas packaging

24 Active packaging, Smart packaging

25 Packaging requirement for raw and processed foods, and their selection of packaging

materials

26 Factors affecting the choice of packaging materials, Disposal and recycle of packaging waste

27 Printing and labelling, Lamination, Package testing

28 Testing methods for flexible materials, rigid materials and semi rigid materials

29 Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test, etc.)

30 Tests for plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer, etc.)

31 Tests for aluminium foil (thickness, pin holes, etc.), glass containers (visual defects, colour, dimensions, impact strength, etc.)

32 Tests for metal containers (pressure test, product compatibility, etc.)

Practical

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 tests for glass containers

5 Vacuum packaging of agricultural produces

6 Determination of tearing strength of paper board

7 Measurement of thickness of packaging materials

8 To perform grease-resistance test in plastic pouches

9 Determination of bursting strength of packaging material

10 Determination of water-vapour transmission rate

11 Shrink wrapping of various horticultural produce

12 Testing of chemical resistance of packaging materials

13 Determination of drop test of food package

14 Visit to relevant food industries

15. Visit to relevant food industries

16. Practical Examination

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PFEN 424 Development of Processed Products 3 (2+1)

Course outlines

Theory

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, Milling, puffing, flaking, Roasting, Bakery products, snack food. Extruded products, oil extraction and refining, Technology for value added products from fruits, vegetables and spices, Canned foods, Frozen foods, dried and fried foods, Fruit juices, Sauce, Sugar based confection, Candy, Fermented food product, spice extracts, 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.

Objectives

To enable the students to understand the process design and flow chart with mass and energy balance, Unit operations and equipments for processing, Technology for value added products from cereals, pulses, oilseeds, fruits, vegetables and spices, Extruded products, Canned and frozen foods, Fruit juices, Technology for animal produce processing.

Lecture

Theory

1 Process design

2 Process flow chart with mass and energy balance – conservation of mass and material balances, conservation of energy and heat balances

3 Unit operations in food Processing – Cleaning, Grading, Size reduction, Separation, Evaporation, Distillation, crystallization, Filtration, Sedimentation and Centrifugation

4 Equipments for food processing

5 Equipments for food processing

6 New products development

7 Technology for value added products from cereals

8 Technology for value added products from pulses

9 Technology for value added products from oilseeds

10 Milling - Terminology related to rice milling, equipment, wheat milling – processing operations, pulse milling

11 Puffing and flaking – Rice flakes, flaking machinery

12 Roasting, bakery products, snack food – Theory, Equipment – batch and semi-continuous ovens, continuous ovens, control of ovens; effect of food and microorganisms

13 Extruded products – extrusion cooking theory, equipment – single screw extruders, twin screw extruder, applications, effects on food and microorganisms

14 Oil extraction and refining – composition and nutritive value, refining and processing of fats, emulsions, rancidity; Supercritical fluid extraction process and its applications

15 Technology for value added products from fruits – processed fruit products, fruit beverages, sugar based products, byproduct utilization of fruits

16 Technology for value added products from vegetables – processed vegetable products, beverages

17 Technology for value added products from spices

18 Canned foods Introduction, canning operations – preparation of food, filling, exhausting, sealing, thermal processing and cooling

19 Frozen foods – concept of freezing, freezing equipment, effect of freezing and frozen storage on foods

20 Dried foods – Theory of drying, drying equipment, effect of nutritional qualities on dried foods

21 Fried foods – Theory of frying, Frying equipment, effect of heating and cooking

22 Fruit juices, sauce – Introduction, preparation of fruit juice – extraction, clarification, filtration, de-aeration, flow charts for different fruit juices

23 Sugar based confection, candy – In-gradients, chocolate and cocoa products, confectionery manufacturing practices, nutritive value, properties and uses of sugar; sugar related products

24 Fermented food products – methods of fermentation – lactic acid fermentation, ethanolic fermentation, mixed alcoholic acid fermentation, definition, benefits of fermentation, microbial changes in foods, controlling fermentations in various foods, microorganisms as direct foods

25 Spice extract – general functions of spices, flavouring extracts and their medicinal value

26 Technology for animal produce processing – Meat; Grading, slaughtering, structure and

composition of meat, Ageing, tenderizing, curing of meat, meat pigments and colour changes, smoking or curing of meat, storage of fresh meat, cooking

27 Processing of poultry – production considerations, processing plant operations, nutritive value, poultry meat products, preservation and storage

28 Processing of fish – classification of sea foods, composition and nutritive value, storage and preservation

29 Processing of egg products – composition, quality factors, egg storage, bacterial infection and pasteurization, freezing, drying; effect of cooking on nutritive value of egg

30 Health foods – Functions of foods and food groups

31 Nutraceuticals and functional foods

32 Organic foods

Practical

1 Process design

2 Preparation of process flow chart

3 Preparation of different value added products

4 Preparation of different value added products

5 Visit to roller wheat flour milling

6 Visit to rice milling

7 Visit to spice grinding mill

8 Visit to milk plant

9 Visit to Dhal mill

10 Visit to oil mill

11 Visit to fruit/vegetable processing plant

12 Study of different operations in fruit/vegetable processing

13 Study of machinery in fruit/vegetable processing

14 Process flow diagram

15 Study of various models of the machines used in a sugar mill

16 Practical Examination

References

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PFEN 425 Process Equipment Design 3 (2+1)

Course outlines

Theory

Introduction on process equipment design, Application of design engineering for processing equipments, Design parameters and general design procedure, Material specification, Types of material for process equipments, Design codes, Pressure vessel design, Design of cleaners. 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 dryers. 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.

Objectives

To enable the students to understand the general procedure of designing different food processing equipment and optimization of the design with respect to process efficiency, energy and cost.

Lecture

Theory

1 Introduction on process equipment design
2 Introduction on process equipment design
3 Introduction on process equipment design
4 Application of design engineering for processing equipments
5 Application of design engineering for processing equipments

6 Application of design engineering for processing equipments
7 Design parameters and general design procedure
8 Design parameters and general design procedure
9 Design parameters and general design procedure
10 Material specification, Types of material for process equipments
11 Material specification, Types of material for process equipments
12 Design codes
13 Pressure vessel design
14 Design of cleaners
15 Design of cleaners
16 Design of tubular heat exchanger
17 Design of shell and tube heat exchanger
18 Design of plate heat exchanger
19 Design of belt conveyer
20 Design of screw conveyer
21 Design of bucket elevator
22 Design of dryers
23 Design of dryers
24 Design of milling equipments
25 Design of milling equipments
26 Optimization of design with respect to process efficiency, energy and cost
27 Optimization of design with respect to process efficiency, energy and cost
28 Optimization of design with respect to process efficiency, energy and cost
29 Computer Aided Design
30 Computer Aided Design
31 Computer Aided Design
32 Computer Aided Design

Practical

1 Design of pressure vessel
2 Design of cleaners
3 Design of milling equipments
4 Design of milling equipments
5 Design of tubular heat exchanger

6 Design of shell and tube type heat exchanger

7 Design of plate heat exchanger

8 Design of dryer

9 Design of dryer

10 Design of belt conveyor

11 Design of belt conveyor

12 Design of bucket elevator

13 Design of bucket elevator

14 Design of screw conveyor

15 Design of screw conveyor

16 Practical Examination

References

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2. Bhattacharyya, B. C. 2008. Introduction to Chemical Equipment Design, CBS Publishers and Distributors, New Delhi.
3. Geankoplis C. J. 2003. Transport Processes and Unit Operations, Prentice-Hall, New York.
4. Rao, D. G. 2010. Fundamentals of Food Engineering PHI Learning Pvt. Ltd, New Delhi.
5. Groover, M. and Zimmers, E. CAD/CAM Computer-aided design and manufacturing. Pearson Education, Inc., New Delhi.

PFEN 426 Waste and By-Products Utilization 3 (2+1)

Course outlines

Theory

Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc., Concept, scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, 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, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste–

trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters , phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation, Effluent treatment plants, Environmental performance of food industry to comply with ISO-14001 standards.

Practical

Determination of temperature, pH, turbidity solids content, BOD and COD of waste water, Determination of ash content of agricultural wastes and determination of un-burnt carbon in ash, Study about briquetting of agricultural residues, Estimation of excess air for better combustion of briquettes, Study of extraction of oil from rice bran, Study on bioconversion of agricultural wastes, Recovery of germ and germ oil from by-products of cereals, Visit to various industries using waste and food by-products.

Objectives

To impart the knowledge of technology of converting low-value by-products from agricultural and food processing industries to economically viable and value added products. Different technologies of waste treatment and environmentally safe disposal will also be targeted.

Lecture

Theory

1 Types and formation of by-products and waste

2 Types and formation of by-products and waste

3 Magnitude of waste generation in different food processing industries

4 Uses of different agricultural by-products from rice mills, sugarcane industry

5 Uses of different agricultural by-products from oil mill

6 Concept, scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD)

7 Concept, scope and maintenance of waste management and effluent treatment, fat, oil and grease content, metal content

8 Forms of phosphorous and sulphur in waste waters

9 Microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues

10 Microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues

11 Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts

12 Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts

13 Briquetting of biomass as fuel, production of charcoal briquette

14 Generation of electricity using surplus biomass

15 Generation of electricity using surplus biomass

16 Producer gas generation and utilization

17 Producer gas generation and utilization

18 Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants

19 Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants

20 Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants

21 Concept of vermin-composting

22 Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation

23 Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation

24 Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation

25 Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons

26 Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons

27 Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons

28 Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters , phosphorous, sulphur, nitrogen and heavy metals removal

29 Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters , phosphorous, sulphur, nitrogen and heavy metals removal

30 Assessment, treatment and disposal of solid waste; and biogas generation, Effluent treatment plants

31 Assessment, treatment and disposal of solid waste; and biogas generation, Effluent treatment plants

32 Environmental performance of food industry to comply with ISO-14001 standards

Practical

1 Determination of temperature and pH of waste water

2 Determination of turbidity and solids content of waste water

3 Determination of BOD of waste water

4 Determination of BOD of waste water

5 Determination of COD of waste water

6 Determination of COD of waste water

7 Determination of ash content of agricultural wastes

8 Determination of un-burnt carbon in ash

9 Study about briquetting of agricultural residues

10 Estimation of excess air for better combustion of briquettes

11 Study of extraction of oil from rice bran

12 Study on bioconversion of agricultural wastes

13 Recovery of germ and germ oil from by-products of cereals

14 Visit to various industries using waste and food by-products.

15 Visit to various industries using waste and food by-products.

16 Practical Examination

References

1. V. K. Joshi & S. K. Sharma. 2011. Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency, Delhi.
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8. R. V. Misra and R. N. Roy.1980. On-farm composting methods, FAO, Rome.

PFEN 427 **Artificial Intelligence** **3(3+0)**

Course outlines

Theory

Foundation and history of artificial intelligent, Problems and Techniques Artificial Intelligence programming languages Introduction to LISP Introduction to PROLOG Problem spaces and searches Blind search strategies Breadth first and Depth first Heuristic search techniques Hill climbing Best first-A* algorithm and AO* algorithm Game tree Minimum maximum algorithms, Game playing, Alpha beta pruning, Knowledge representation issues, Predicate logic, Logic programming, Semantic nets, Frames and inheritance, Constraint propagation, Representing knowledge using rules, Rules based deduction systems, Reasoning under uncertainty, Review of probability, Baye's probabilistic interferences Dempster Shafer theory, Heuristic methods, Symbolic reasoning under uncertainty, Statistical reasoning, Fuzzy reasoning, Temporal reasoning, Non monotonic reasoning, Planning and planning in situational calculus, Representation for planning, Partial order planning algorithm, Learning from examples, Discovery as learning, Learning by analogy, Explanation based learning, Neural nets, Genetic algorithms, Principles of Natural language processing, Rule based systems architecture, Expert systems, Knowledge acquisition concepts, Artificial Intelligence application to robotics, Current trends in intelligent system

Lecture

Theory

1 Foundation and history of artificial intelligent
2 Problems and Techniques
3 Artificial Intelligence programming languages
4 Introduction to LISP
5 Introduction to PROLOG
6 Problem spaces and searches
7 Blind search strategies
8 Breadth first and Depth first
9 Heuristic search techniques
10 Hill climbing
11 Best first-A* algorithm and AO* algorithm
12 Game tree
13 Minimum & maximum algorithms
14 Game playing
15 Alpha beta pruning

16 Knowledge representation issues
17 Predicate logic
18 Logic programming
19 Semantic nets
20 Frames and inheritance
21 Constraint propagation
22 Representing knowledge using rules
23 Rules based deduction systems
24 Reasoning under uncertainty
25 Review of probability
26 Baye's probabilistic interferences
27 Dempster Shafer theory
28 Heuristic methods
29 Symbolic reasoning under uncertainty
30 Statistical reasoning
31 Fuzzy reasoning
32 Temporal reasoning
33 Non monotonic reasoning
34 Planning and planning in situational calculus
35 Representation for planning
36 Partial order planning algorithm
37 Learning from examples
38 Discovery as learning
39 Learning by analogy
40 Explanation based learning
41 Neural nets
42 Genetic algorithms
43 Principles of Natural language processing
44 Rule based systems architecture
45 Expert systems
46 Knowledge acquisition concepts
47 Artificial Intelligence application to robotics
48 Current trends in intelligent system

References

1. Russell, S. and P. Norvig. 1998. Artificial Intelligence: A Modern Approach. Prentice Hall, USA.
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IDEN 431 Management of Canal Irrigation System 3(2+1)

Course outlines

Theory

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, 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, maintenance of unlined irrigation canals, measurement of discharge in canals, rostering (canal running schedule) and warabandhi, necessity of canal lining: advantages and disadvantages, types of canal lining and desirable characteristics for the suitability of lining materials; design of lined canals; functions of distributary 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; design of lined canals; formulation of warabandhi; Study of canal outlets, regulators, escapes and canal falls.

Objectives

To enable the students to understand the principles and to acquire knowledge on canal irrigation system and its components, canal alignment, performance indicators for canal irrigation system evaluation, crop water requirement in canal command area and canal capacity, design of canals, canal lining, canal falls and surplus weirs.

Lecture

Theory

1 Irrigation: Definition, purpose, benefits and ill effects

2 Typical network of canal irrigation system and its different physical components, planning and layout of distribution systems

3 Canal classification based on source of water, financial output, purpose, discharge

4 Canal alignment: General conditions for alignment of canals, distribution system for canal irrigation, factors affecting the canal alignment and curves in Channels

5 Certain important definitions related to command area: GCA, CCA, Intensity of irrigation, Time factor, capacity factor, full supply coefficient, nominal duty etc.

6 Performance indicators for canal irrigation system evaluation

7 Estimation of water requirements: for canal command areas and determination of canal capacity: Inductive methods

8 Estimation of water requirements: Critical growth period method and consumptive use method

9 Water duty and delta, Duty at various places, flow duty and quantity duty, factors affecting duty, importance of duty and duty of some important crops and measures for improving duty

10 Relationship between duty, base period and delta with problems

11 Computing the design discharge capacity of an Irrigation canal

12 Estimation of water losses in canals: Evaporation, Seepage with empirical formulas and canal regulation

13 Design of channels: Design of Non- alluvial channels

14 Design of lined canals: Triangular section and trapezoidal section

15 Design of alluvial channels by Kennedy's Silt theory

16 Design of alluvial channels by Kennedy's theory

17 Design of alluvial channels by Lacey's regime theory

18 Design of alluvial channels by Lacey's basic regime equations

19 Drawbacks of Kennedy's theory and Lacey's theory, Comparison of Kennedy's theory and Lacey's theory

20 Maintenance of unlined irrigation canals: silting of canals, weed and plant growth, failure of weaker banks and canal breaches

21 Measurement of discharge in channels and problems

22 Rostering (canal running schedule) and warabandhi

23 Canal lining: Necessity, advantages and disadvantages, types of canal lining

24 Desirable characteristics of the suitability of lining materials: In-situ concrete lining, precast concrete lining, Cement mortar lining, lime concrete lining

25 Brick lining, stone block lining or boulder lining, asphalt concrete lining, buried membrane lining, earth lining and porous lining

26 Canal regulation works: Functions of distributary head and cross regulators and it's design.

27 Devices for sediment control and silt selective distributary head regulator

28 Canal falls: Necessity and factors affecting canal fall

29 Development of different types of canal falls and classification of falls based on approach conditions.

30 Surplus water escape, canal scouring escape and tail escape

31 Canal outlets: Requirements of a good canal outlet and types of outlet

32 Criteria for selection of outlet capacity, Non-modular and modular outlets

Practical

1 Layout of canal alignments on topographic maps

2 Problems on relationship between duty, base period and delta

3 Estimation of Consumptive use or evapotranspiration

4 Estimation of water requirements for canal command areas and determination of canal capacity

5 Computing the design discharge capacity of an Irrigation canal

6 Problems on design of Non- alluvial channels

7 Problems on design of lined canals with Triangular section and trapezoidal section

8 Problems on design of alluvial channels by Kennedy's Silt theory

9 Problems on design of alluvial channels by Kennedy's theory

10 Problems on design of alluvial channels by Lacey's regime theory

11 Problems on design of alluvial channels by Lacey's basic regime equations

12 Problems on measurement of discharge in channels and problems

13 Formulation of warabandhi – preparation of irrigation schedule

14 Study of canal outlets and regulators

15 Study of escapes and canal falls

16 Practical Examination

References

1. Arora, K. R. 2001. Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.

2. Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.

3. Sahasrabudhe S. R. 2011. Irrigation Engineering and Hydraulic structures. SK Kataria & Sons, New Delhi.

IDEN 432 Minor Irrigation and Command Area Development 3(2+1)

Course outlines

Theory

Minor irrigation-Factors affecting performance of irrigation projects; types of minor irrigation systems in India; 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; command area development (CAD) programme- components, need, 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; water productivity: concepts and measures for enhancing water productivity; Farmers' participation in command area development

Practical

Preparation of command area development layout plan; 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, design of lift irrigation system, use of RS techniques for CAD works, measures for enhancing water productivity, Farmers participation in CAD works, Visits to nearby tank system, lift irrigation scheme and command area.

Objectives

To enable the students to understand the principles and to acquire knowledge on minor irrigation projects, plan, design and execute tanks, wells, pumping houses, diversion schemes, open field channels for efficient conveyance and application of irrigation water and for development of command areas of different sources under minor irrigation

Lecture

Theory

1 Introduction to Minor Irrigation, Types of minor irrigation systems in India, Major, Medium and Minor projects

2 Factors affecting performance of the above projects

3 Development and utilization of water resources through different minor irrigation schemes

4 Lift Irrigation systems- Assessment of feasibility of lift irrigation projects, water availability, water lifting from canals, water lifting permission

5 Types of river and canal pumping systems and their site selection, design of lift irrigation systems, intake structure and main points to be considered for designing intake structure and intake pipe

6 Intake pipe – supporting strength and vertical load, design problem

7 Tank Irrigation- Components of irrigation tanks, earthen bund, surplus weir, sluices and channels, basis for formation of tanks

8 Grouping of tanks, Storage capacity and number of fillings of tanks, number of rainy days and working table

9 Supply works and sluices, Earthen Bunds- Reasons for general failure- Filter criteria, cutoff, upstream blanket, prevention of breaching of tanks

10 Bank section, stability of side slopes, top widths and free boards, failure by slipping or sliding, failure by over topping

11 Diversion Schemes-Hydrology, components of diversion schemes, locations and design of weirs

12 Surplus weirs-estimation of flood discharge entering the tanks, design of surplus weirs, length, crest width and base width

13 Basic Concepts of command area development (CAD) programme – definition, need, scope and development

14 Technical details about various components of CAD water management programme

15 Historical perspective, command area development authorities-functions and responsibilities

16 Approach to planning, construction and maintenance of on farm development works

17 Survey and investigation of on farm development activities within the scope of command area development

18 Layout and alignment of field channels

19 Water delivery system – channel design

20 Water delivery system – control structures

21 Water delivery system – control structures for black cotton soils

22 Flow measuring devices for field channels

23 Materials for lining water courses and field channels

24 Reclamation components of waterlogged areas in irrigation commands

25 Management components of waterlogged areas in irrigation commands

26 Use of remote sensing techniques for command area development works

27 Basics of Remote sensing and Geographic information systems

28 Water productivity- Definitions and conceptual framework

29 Methodology to work out water productivity

30 Measures for enhancing water productivity

31 Farmers participation in command area development

32 Case study of farmers participation in Andhra Pradesh

Practical

1 Preparation of command area development layout plan
2 Irrigation water requirement of crops
3 Irrigation water requirement of crops
4 Preparation of irrigation schedules
5 Planning and layout of water conveyance system
6 Design of surplus weir of tanks
7 Determination of storage capacity of tanks
8 Design of intake pipe and pump house
9 Design of lift irrigation systems
10 Use of remote sensing techniques for CAD works
11 Measures for enhancing water productivity
12 Farmers' participation in command area development
13 Visit to nearby Tank irrigation system
14 Visit to nearby Lift irrigation system
15 Visit to nearby Command area
16 Practical Examination

References

1. Arora, K. R. 2001. Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.
2. Garg S. K. 2014. Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.
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IDEN 433 Water Quality and Management Measures 3(2+1)

Course outlines

Theory

Introduction to water pollution, Agricultural impacts on water quality, 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, 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. Physical, chemical, bacterial and microscopical characteristics of water, Pathogenic and non-pathogenic bacteria and their testing, Arsenic and fluoride contamination in groundwater and remedial measures, water decontamination technologies, desalination, cultural and management practices for using poor quality water for irrigation. Management practices for sustained saline water use, Irrigation with poor quality of water and Water quality Guidelines 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.

Objectives

To enable the student to understand the principles and to acquire knowledge on water quality, classification of irrigation water, water contamination due to inorganic and organic compounds, agricultural chemicals, food industry, water decontamination technologies and management practices for sustained saline water use, irrigation with poor quality of water and water qualities for irrigation water.

Lecture

Theory

1 Introduction to water pollution: Water quality as a global issue and scope of the problem

2 Agricultural impacts on water quality: Types of impacts, irrigation impacts on surface water quality and public health impacts

3 Natural factors affecting quality of surface water and groundwater

4 Water quality objectives in relation to domestic, industrial and agricultural activities

5 Quality standards of drinking water (Municipal or domestic supplies) as per WHO and BIS specifications

6 Quality of irrigation water: Parameters for water quality assessment

7 Salinity hazard, sodicity hazard and toxicity hazard

8 Water quality criteria for its suitability and Quality of surface and groundwater sources

9 Classification of Irrigation water as per USSL based on salinity and sodicity

10 Classification of Irrigation water as per All Indian Coordinated Research Project (AICRP) criteria

11 Point and non-point water pollution sources, Classes of point and non-point water pollution sources. Water contamination due to inorganic and organic compounds

12 Water contamination related to agricultural chemicals : Fertilizers as water pollutants and control measures

13 Water contamination related to agricultural chemicals : Pesticides as water pollutants and control measures

14 Water contamination related to food industry

15 Water contamination related to hydrocarbon and synthetic organic compounds

16 Characteristics of water: Physical characteristics of water and their measurement

17 Chemical characteristics of water and their measurement

18 Bacterial and microscopical characteristics of water

19 Pathogenic and non-pathogenic bacteria and their testing through MPN index

20 Arsenic contamination and its removal from water

21 Fluoride contamination and its removal from water

22 Water decontamination technologies: Methods of purification (decontamination) of water

23 Screening: Course and fine screens and their working

24 Plain sedimentation: Theory of sedimentation and Sediment tanks

25 Sedimentation aided with coagulation: Analysis of flocculent settling and Chemicals used for coagulation

26 Filtration: Theory of filtration, filter materials, type of filters and their classification

27 Sterilization: Methods of disinfection and chlorination

28 Water softening: Methods of removing temporary and permanent hardness

29 Removal of colors, odours and tastes from water

30 Desalination : Removal of salts and dissolved solids from water

31 Cultural and management practices for using poor quality water for irrigation

32 Management practices for sustained saline water use, Irrigation with poor quality of water and Water quality Guidelines for irrigation

Practical

1 Water quality analysis: Determination of EC and pH of solution

2 Water quality analysis: Determination of suspended and dissolves solids

3 Water quality analysis: Determination of total solids

4 Water quality analysis: Determination of turbidity

5 Water quality analysis: Determination of temporary hardness

6 Water quality analysis: Determination of permanent hardness

7 Soil chemical analysis: Estimation of N, P and K

8 Soil chemical analysis: Estimation of Na, Mg and Ca

9 Estimation of lime and gypsum requirements for reclamation of the problematic soils

10 Study of salinity development under shallow and deep water table conditions

11 Study of contamination movement and transport in soil profile

12 Study of different water decontamination techniques: sedimentation tanks

13 Study of different water decontamination techniques: Filters and water softening

14 Study of different cultural and management practices for using poor quality water for irrigation

15 Field visit to industrial effluent disposal sites

16 Practical Examination

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IDEN 434 Landscape Irrigation Design and Management 3(2+1)

Course outlines

Theory

Introduction to landscaping - Definition of landscape, Historical importance of Indian gardens and history of gardening in different eras , Famous gardens of India and study of their methods of irrigation systems ; 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, shrub adopter, drip irrigation and bubblers; Merits and demerits of conventional and modern irrigation systems, 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; Automation system for landscape irrigation- main components, types of controllers and their application, Design of modern landscape irrigation systems, operation and maintenance of landscape irrigation systems. Use of soft-wares in irrigation design.

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.

Objectives

To enable the student to understand the principles and to acquire knowledge on basic concepts of land scape, conventional and modern methods of landscape irrigation, components of modern landscape irrigation systems and their selection criteria, design, layout, operation and maintenance of modern landscape irrigation systems and using computer softwares for designing landscape irrigation systems.

Lecture

Theory

1 Definition of landscape, Historical importance of Indian gardens and history of gardening in different eras

2 Famous gardens of India and study of their methods of irrigation systems

3 Conventional methods of landscape irrigation, study of hose irrigation system and their components

4 Study of components of portable sprinkler with hose pipes

5 Study of Modern methods of landscape irrigation: Pop up sprinklers and their components and selection criteria

6 Design criteria for pop-up sprinkler systems in landscaping

7 Study of shrub adopter sprinkler system and their accessories

8 Types of drip irrigation methods adopted in landscaping and their components

9 Design and layout of drip irrigation system in landscaping

10 Design of bubbler irrigation system, selection in landscaping

11 Study of merits and demerits of conventional landscape irrigation systems

12 Types of modern landscape irrigation methods and their merits and demerits

13 Landscape - Types of landscapes: Natural landscapes, Human made landscapes

14 Landscape - Basic theme of gardens viz. circular, rectangular and diagonal themes

15 Factors affecting landscape design viz. initial approach, view, human choice, simplicity and topography

16 Suitability of different types irrigation systems for landscapes

17 Water requirement for different landscapes

18 Numerical problems on water requirements of landscapes

19 Segments of landscape irrigation systems

20 Main components of modern landscape irrigation systems and their selection criteria

21 Types of pipes and pressure ratings in landscape irrigation and their selection criteria

22 Study of economics of pipes used in landscape irrigation and their selection

23 Numerical problems on economics of pipe selection

24 Study of different automation systems for landscape irrigation

25 Study of main components, types of controllers and their application in automation system

26 Design and layout of modern landscape irrigation systems

27 Problems on design and layout of modern landscape irrigation systems

28 Operation of landscape irrigation systems

29 Maintenance of landscape irrigation systems

30 Use of soft-wares in irrigation design : AutoCAD and Archi-CAD

31 Design of landscape irrigation systems using AutoCAD

32 Design of landscape irrigation systems using Archi-CAD

Practical

1 Study of various irrigation equipment for landscapes

2 Determination of water requirement for different landscapes

3 Design and installation of irrigation system for landscape

4 Determination of power requirements for irrigation systems

5 Tutorial problems on pump selection and power requirement

6 Preparation of irrigation scheduling of landscapes

7 Study of irrigation controllers and other equipments

8 Study of blocks & symbols, head layout

9 Study of zoning and valves layout

10 Study of pipe sizing, Pressure calculations

11 Acquaintance in use of AutoCAD and Archi-CAD

12 Use of AutoCAD in designing of gardens

13 Use of AutoCAD in design of irrigation systems

14 Visit to nearby landscape irrigation system

15 Evaluation of landscape irrigation system observed in field visit

16 Practical Examination

References

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IDEN 435 Plastic Applications in Agriculture 3 (2+1)

Course outlines

Theory

Introduction of plasti-culture - 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 plasti-culture in India. 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. Drip and sprinkler irrigation systems. Use of polymers in control of percolation losses in fields. Soil conditioning - soil solarization, effects of different colour, plastic mulching in surface covered cultivation. 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. Plastic fencing. Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products. Plastic cap covers for storage of food grains in open. Use of plastics as alternate material for manufacturing farm equipment and machinery. Plastics for aqua cultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries. Silage film technique for fodder preservation. Agencies involved in the promotion of plasti-culture in agriculture at national and state level. Human resource development in plasti-culture applications.

Practical

Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting ponds. Study of plastic components of drip and sprinkler irrigation systems, laying and flushing of laterals. Study of components of subsurface drainage system. Study of different colour plastic mulch laying. Design, estimation and installation of green, poly and shade net

houses, low tunnels etc. Study on cap covers for food grain storage, innovative packaging solutions - leno bags, crates, bins, boxes, vacuum packing, unit packaging, CAS and MAP and estimation. Study on use of plastics in nursery, plant protection, inland fisheries, animal shelters, preparation of vermi-bed and silage film for fodder preservation. Study of plastic parts in making farm machinery. Visits to nearby manufacturing units/dealers of PVC pipes, drip and sprinkler irrigation systems, greenhouse/ polyhouse/ shadehouse/ nethouse etc. Visits to farmers' fields with these installations.

Objectives

To impart knowledge about the plasti-culture and quality of plastics used in soil and water conservation, production agriculture and post harvest management. To get knowledge on the use of plastics in various fields like protected cultivation, water management in both irrigation and drainage systems, soil and water conservation measures, storage and packing of produce, aqua cultural engineering and animal husbandry.

Lecture

Theory

1 Introduction of plasti-culture - types and quality of plastics used in soil and water conservation, production agriculture and post harvest management

2 Quality control measures, Present status and future prospective of plasti-culture in India

3 Different types of the plastic material and its raw material

4 Characteristics of different plastic materials and its market potential

5 Use of plastics in in-situ moisture conservation as water management technique

6 Use of plastics in rain water harvesting

7 Plastic film lining in canal, pond and reservoir

8 Plastic pipes for irrigation water management

9 Plastic pipes for bore-well casing

10 Plastic pipes for subsurface drainage

11 Plastic pipes use in sprinkler irrigation system – Advantages and various components of sprinkler irrigation systems

12 Plastic pipes use in drip irrigation system – Advantages and various components of drip irrigation systems

13 Manufacturing of plastic pipes - The various process steps involved in the manufacture of plastic pipes

14 Use of polymers in control of percolation losses in fields.

15 Plastics used in soil conditioning - soil solarization

16 Effects of different colored plastic mulching in surface covered cultivation

17 Nursery management - Use of plastics in nursery raising, nursery bags, trays

18 Controlled environmental cultivation - plastics as cladding material in green / poly houses

19 Controlled environmental cultivation - plastics as cladding material in shade net houses

20 Controlled environmental cultivation - plastics as cladding material in poly tunnels

21 Plastic nets for crop protection - anti insect nets, bird protection nets. Plastic fencing

22 Plastics use in drying of agricultural produce

23 Plastics use in preservation of food

24 Handling and storage of agricultural produce

25 Innovative plastic packaging solutions for processed food products

26 Plastic cap covers for storage of food grains in open

27 Use of plastics as alternate material for manufacturing farm equipment and machinery

28 Plastics for aqua cultural engineering for inland fisheries

29 Plastics for animal husbandry - animal shelters, vermi-beds

30 Silage film technique for fodder preservation

31 Agencies involved in the promotion of plasti-culture in agriculture at national and state level

32 Human resource development in plasti-culture applications

Practical

1 Design, estimation and laying of plastic films in lining of canal

2 Design, estimation and laying of plastic films in water harvesting ponds

3 Study of plastic components of sprinkler irrigation system

4 Study of plastic components of drip irrigation system

5 Study of components of subsurface drainage system

6 Study of different colour plastic mulch laying

7 Design, estimation and installation of green / poly houses

8 Design, estimation and installation of shade net houses

9 Design, estimation and installation of low tunnels

10 Study on cap covers for food grain storage, innovative packaging solutions - leno bags, crates, bins, boxes, vacuum packing, unit packaging, CAS and MAP and estimation

11 Study on use of plastics in nursery and plant protection

12 Study on use of plastics in aquaculture

13 Study on use of plastics in animal husbandry

14 Study of plastic parts in making farm machinery

15 Visit to nearby manufacturing units/dealers of PVC pipes, drip and sprinkler irrigation systems, greenhouse/ polyhouse /shadenet house

16 Practical Examination

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SWCE 441 Floods and Control Measures 3(2+1)

Course outlines

Theory

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 fore-casting. 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. 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, 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. 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.

Objectives

To know about the causes of floods and its occurrence, flood classification and estimation. To impart knowledge on the methods of flood forecasting and flood control measures, seepage analysis and design of earthen dam, subsurface dams and check dams.

Lecture

Theory

1 Floods - causes of flood and its occurrence

2 flood classification - probable maximum flood, standard project flood, design flood, observed maximum flood, peak flood, annual flood, ordinary flood, foundation design flood

3 Flood estimation - methods of estimation; estimation of flood peak - rational method, envelope curve method

4 Flood estimation -empirical methods- Rave's formula-, Nawab Jang Bahadur formula, Creager's formula, Modified Myer's formulas - Bourge's formula

5	Flood estimation- unit hydrograph method- Probability or statistical methods
6	Statistics in hydrology, flood frequency methods - log normal, Gumbel's extreme value
7	Log-Pearson type-III distribution; depth-area-duration analysis
8	Flood forecasting- Flood routing - channel routing, Muskingum method
9	Flood forecasting- reservoir routing, modified Pul's method
10	Flood control - history of flood control, structural and non-structural measures of flood control
11	Storage and detention reservoirs, levees, channel improvement
12	Gully erosion and its control structures - vegetative methods, construction of temporary structures
13	Permanent gully control structures - design of permanent structures and implementation
14	Ravine- types- ravine control measures- spillways -classification
15	River training works – types – embankments- guide banks- Spurs or Groynes, Impermeable Groynes, Permeable Groynes, Bed Pitching and Bank Revetment
16	Dredging of River, Types of Dredgers - Bucket or grab dredger, Dipper dredger, Ladder dredger, Suction cutter head dredger
17	Planning of flood control projects and their economics
18	Earthen embankments - functions, classification - hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type
19	Pore water pressure and its significance in the design of earth dam. Foundation requirements, grouting, seepage through dams
20	Flow net and its properties, seepage pressure, causes of failures of earthen dams
21	Seepage line in composite earth embankments, Seepage discharge through isotropic and non-isotropic soils, drainage filters, piping and its causes
22	Design and construction of earthen dam- free board, width, upstream and downstream slopes
23	Stability of earthen embankments against failure by tension, overturning, sliding
24	Stability of earthen slopes – Determination of pore pressure from flow net, friction circle
25	Stability of earthen slopes – Stability of downstream slope during during steady seepage
26	Stability of earthen slopes – Stability of upstream seepage during sudden drawdown
27	Analysis of failure by different methods. –Gravity method, elementary profile
28	Subsurface dams - site selection – preliminary investigations and constructional features
29	Check dam - Small earthen embankments – types- Arch dam, Gravity dams, Arch-gravity dams, Barrages, Embankment dams, Concrete-face rock-fill dams, Earth-fill dams
30	Design criteria for check dams

31 Subsurface dams – sand dams-basic principle- advantages and disadvantages

32 Design and site selection, constructional features of sub surface dams

Practical

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. Determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution

4 Determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution

5 Determination of probable maximum flood, standard project flood and spillway design flood

6 Design of levees and jetties for flood control

7 Design of gully/ravine control structures (vegetative and structural measures for gully stabilization) and cost estimation

8 Designing, planning and cost- benefit analysis of a flood control project

9 Study of different types, materials and design considerations of earthen dams

10 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

11 Stability of slopes of earth dams by friction circle and other methods

12 Construction of flow net for isotropic and anisotropic media

13 Computation of seepage by different methods

14 Determination of settlement of earth dam. Input-output-storage relationships by reservoir routing

15 Visit to sites of earthen dam and water harvesting structures

16 Practical Examination

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SWCE 442 Wasteland Development 3(2+1)

Course outlines

Theory

Land degradation – concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands and assessment. 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. 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. 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. 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.

Objectives

To impart knowledge on concept and causes of land degradation, assessment of land degradation and wasteland development. To study about socio-economic perspectives of sustainable wasteland development, government policies and participatory approach.

Lecture

Theory

1 Land degradation – concept, causes of land degradation - Deforestation, Agricultural practices, Industrialization, Urbanization, forest degradation, rangeland degradation

2 Classification of land degradation in arid, semiarid, humid and sub-humid regions

3 Denuded range land and marginal lands

4 Natural degradation hazards- water erosion, wind erosion, water logging, salinization, decline in soil fertility

5 Land degradation assessment- land, population, poverty and degradation

6 Wastelands - factors causing, types of waste lands (NWDB) classification

7 Mapping of wastelands of different categories in India

8 Planning of wastelands development – on going waste land development schemes – criteria for site selection, constraints, agro-climatic conditions

9 Development options, estimation of financial requirements and contingency plans

10 Conservation structures - gully stabilization, ravine rehabilitation

11 Sand dune stabilization

12 Water harvesting and recycling methods

13 Afforestation – land preparation methods, agro-horti-forestry-silvipasture methods

14 Afforestation – forage and fuel crops - socioeconomic constraints

15 Shifting cultivation, optimal land use options

16 Wasteland development – hills

17 Wasteland development – semi-arid areas- insitu conservation measures

18 Wasteland development – coastal areas

19 Wasteland development – water scarce areas

20 Wasteland development – reclamation of waterlogged and salt-affected lands

21 Mine spoils- impact, land degradation, impact on environment

22 Reclamation and rehabilitation, slope stabilization of mine spoils

23 Management of mine environment

24 Micro-irrigation in wastelands development

25 Sustainable wasteland development - drought situations, tree based farming, horticulture, cash crops, use of bio-fertilizers

26 Sustainable wasteland development of pasture on village common lands and improved livestock management

27 Socio-economic perspectives of sustainable wasteland development

28 Government policies in wasteland development

29 Participatory approach for wasteland development

30 Impact assessment of wasteland development

31 Preparation of proposal for wasteland development

32 Analysis of benefit-cost of wasteland development

Practical

1 Mapping of wastelands using RS and GIS techniques

2 Classification of wastelands

3 Identification of factors causing wastelands

4 Estimation of vegetation density and classification

5 Planning and design of engineering measures for reclamation of wastelands in hills.

6 Planning and design of engineering measures for reclamation of wastelands in semi arid areas & water scarce areas

7 Planning and design of engineering measures for reclamation of wastelands in coastal areas

8 Planning and design of engineering measures for reclamation of wastelands in mine spoils

9 Planning and design of engineering measures for reclamation of wastelands in waterlogged and salt affected areas

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 Cost estimation of the above measures / structures

15 Visit to wasteland development project sites

16 Practical Examination

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SWCE 443 Information Technology for Land and Water Management 3 (2+1)

Course outlines

Theory

Introduction to Information Technology (IT), Concept of 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. Networking system of information. Problems and prospects of new information and communication technology. Multiple criteria decision analysis for natural resource management. Development of database concept for effective natural resources management. Application of remote sensing, geographic information system (GIS) and GPS in natural resource inventory, soil mapping and watershed management. Use of satellite data for monitoring the changes in land water resources. Rational data base management system. Object oriented approaches. Information system, decision support systems and expert systems. 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.

Objectives

To aim the students to get knowledge about information technology, database, multimedia technologies, Networking system and communication technology etc.

Lecture

Theory

1 Information Technology (IT) –introduction- Users' needs in terms of land and water information systems and decision-support systems

2 Information Technology concepts and its application potential

3 Role of IT in natural resources management in modern irrigation sector

4 Existing system of information generation in land water management and organizations involved in the field of land and water management

5 Multimedia technologies – introduction - Applications

6 Role of multi-media in the development of natural resources

7 Internet application tools in water management planning

8 Web technology- Introduction – study of websites available for information on land and water resources

9 Networking system of information- Introduction- types – study of water supply networks

10 Global network on water and development information for arid lands (G-WADI)

11 Communication technology - the role of communication technology in land and water information systems

12 Problems and prospects of new information and communication technology

13 Multiple criteria decision analysis for integrated land resources planning and management

14 Database- introduction- types of database management systems

15 Different data base systems in land and water management

16 Development of database concept for effective natural resources management

17 RS & GIS - Application of remote sensing, geographic information system (GIS) and GPS in thematic mapping like soil, water, ground water, resource, ground water, drainage

18 RS & GIS - Application of remote sensing, geographic information system (GIS) and GPS in natural resource inventory

19 RS & GIS - Application of remote sensing, geographic information system (GIS) and GPS in soil mapping

20 RS & GIS - Application of remote sensing, geographic information system (GIS) and GPS in Watershed characterization, Watershed prioritization, Inventory & assessment of natural resources, Wasteland mapping, Ground water potential zones, Run off estimation, Water resources action plan, Land resources action plan, Site selection for implementation, Land resource and evaluation

21 RS & GIS - Use of Satellite Data for Monitoring the Changes in land and water

22 Rational data base management system- definition- Special application in land and water management(FAO)

23 Object oriented approach – principle- object oriented approaches in water resource planning, flood planning, water quality monitoring

24 Information system – overview- types of information systems- development – integrated land and water information systems

25 Decision support systems- elements- support elements, water availability elements, water demand elements, integrated water management elements

26 Expert systems in relation to water management

27 Agricultural information management systems – Models – types of models

28 Mathematical models in irrigation, optimization and water resource management

29 Mathematical models in soil and water conservation

30 Application of decision support systems, multi sensor data loggers

31 Overview of software packages in natural resource management

32 Video-conferencing of scientific information

Practical

1 Study of role of IT in natural resources management

2 Study of Internet applications: E-mail, voice mail, web tools and technologies

3 Study of Multimedia production using different soft-wares

4 Study of Handling and maintenance of new information technologies and exploiting their potentials

5 Exercises on database management using database programs and spreadsheet programs

6 Study of RS satellites for land and water information generation

7 Study of GIS tools for image processing

8 GPS survey and processing

9 Exercise on computer software packages dealing with water balance

10 Exercise on crop production

11 Exercise on land development, land and water allocation

12 Exercise on watershed analysis

13 Exercises on simple decision support and expert systems for management of natural resources

14 Exercises on development of information system on selected theme(s)

15 Video-conferencing of scientific information

16 Practical Examination

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SWCE 444 Remote Sensing and GIS Applications 3 (2+1)

Course outlines

Theory

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; 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; photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; 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; microwave remote sensing. 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, 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.

Objectives

To equip the students with the knowledge on techniques of Remote Sensing and GIS applications for land and water resources management with projections on yield response to irrigation water, mapping of salt affected and waterlogged lands and techniques of image processing for various applications in efficient natural resources management.

Lecture

Theory

1 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

2 Electromagnetic spectrum- different bands –Resolution

3 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

7 Important features of Indian Remote Sensing Satellites

8 Contrast ratio and possible causes of low contrast

9 Aerial photography; types of aerial photographs

10 Scale of aerial photographs, planning aerial photography- end lap and side lap

11 Stereoscopic vision, requirements of stereoscopic photographs

12 Air-photo interpretation- interpretation elements

13 Photogrammetry- measurements on a single vertical aerial photograph

14 Measurements on a stereo-pair- vertical measurements by the parallax method

15 Ground control for aerial photography; satellite remote sensing

16 Multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions

17 Analysis of digital data- image restoration

18 Image enhancement

19 Information extraction, image classification

20 Unsupervised classification, supervised classification

21 Important consideration in the identification of training areas, vegetation indices; microwave remote sensing

22 GIS and basic components

23 different sources of spatial data, basic spatial entities

24 major components of spatial data

25 Basic classes of map projections and their properties

26 Methods of data input into GIS

27 Data editing, spatial data models and structures

28 Attribute data management

29 integrating data (map overlay) in GIS

30 Application of remote sensing and GIS for the management of land and water resources

31 Application of remote sensing and GIS in water resources development

32 Application of remote sensing and GIS in soil conservation

Practical

1 Familiarization with remote sensing and GIS hardware

2 Use of software for image interpretation

3 Interpretation of aerial photographs and satellite imagery

4 Basic GIS operations such as image display

5 Study of various features of GIS software package

6 Scanning & Digitization of maps

7 Digitization of maps and data editing

8 Digitization of maps and data editing

9 Data base query and map algebra

10 Data base query and map algebra

11 Application of remote sensing and GIS in water resources development

12 Application of remote sensing and GIS in soil conservation

13 Application of remote sensing and GIS in yield assessment

14 Application of remote sensing and GIS in geology and soil mapping

15 Application of remote sensing and GIS in watershed management

16 Practical Examination

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SWCE 445 Precision Farming Techniques for Protected Cultivation 3 (2+1)

Course outlines

Theory

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. 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. 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. 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.

Objectives

To impart knowledge about the precision farming to get more profit with high water use efficiency. The construction and operational details of the green/poly houses will lead the students not only to grow crops with profits but also use the greenhouses for off-season usage and also to manage them commercially.

Lecture

Theory

1 Protected cultivation: Introduction, History, origin, development, National and International Scenario

2 Types of green houses, polyhouses /shade nets

3 Components of green house, polyhouses /shade nets

4 Different types of cladding materials for green houses, polyhouses /shade net houses

5 Plant environment interactions – principles of limiting factors, solar radiation and transpiration

6 Greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment

7 Design of green houses – site selection, orientation, design

8 Construction of green houses

9 Design for ventilation requirement using exhaust fan system, selection of equipment

10 Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators (natural ventilation)

11 Greenhouse cooling system - evaporative cooling system

12 Greenhouse cooling system - fogging cooling system

13 Combined fogging and fan - pad cooling system

14 Design of cooling system of cooling and ventilation systems, pad care

15 Maintenance of cooling and ventilation systems, pad care

16 Greenhouse heating – necessity, equipment, methods and design of heating system in green houses

17 Root media – types – soil and soil less media, composition, estimation, preparation and disinfection, bed preparation

18 Suitable crops under greenhouse / net houses and planting techniques

19 Irrigation in greenhouse and net house – Water quality, methods and components of irrigation system

20 Design, installation and material requirement for irrigation systems in greenhouse and shade net house

21 Fogging system for humidity control in greenhouses and net houses – introduction, benefits, design

22 Installation and material requirement for fogging system for greenhouses and shade net houses

23 Maintenance of irrigation and fogging systems

24 Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, methods for fertilizer application

25 Principles of selection of proper application of fertilizers, Fertilizer scheduling, rate of application of fertilizers

26 Automated fertilizer application in the greenhouses and net houses

27 Greenhouse climate measurement, control and management practices

28 Insect and disease management in greenhouse and net houses

29 Selection of crops for greenhouse cultivation, major crops in greenhouse and their irrigation requirement

30 Fertilizer management, cultivation, harvesting and post harvest techniques for different crops under greenhouse

31 Economic analysis of greenhouse cultivation

32 Economic analysis of shade net house cultivation

Practical

1 Design of greenhouses/ polyhouses , shade net houses

2 Estimation of material requirement for construction of greenhouse

3 Determination of fertilization schedule and rate of application for various crops

4 Estimation of material requirement for preparation of root media

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 fogging system

9 Study of greenhouse heating

10 Study of different greenhouse environment control instruments

11 Study of operation maintenance and fault detection in irrigation system

12 Study of operation maintenance and fault detection in fogging system

13 Economic analysis of greenhouses and net houses

14 Economic analysis of shade net houses

15 Visit to greenhouses/poly houses, shade net houses

16 Practical Examination

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REEN 451 Photovoltaic Technology and Systems 3 (2+1)

Course outlines

Theory

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. 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. Balance of Solar PV system: Introduction to batteries, battery classification, lead acid battery, Nicked Cadmium battery, comparison of batteries, battery parameters, Charge controller: types of charge controller, function of charge controller, PWM type, MPPT type charge controller, Converters: DC to DC converter and DC to AC type converter. 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, Study of Map, Safe measurement of PV modules electrical characteristics and Commissioning of complete solar PV system.

Objectives

To enable the students to acquire knowledge on solar photovoltaic system, types of solar cell, solar photovoltaic module, battery classification, types of charge controller, converters and applications of solar photovoltaic system.

Lecture

Theory

1 Solar PV technology: current Status of PV technology

2 Advantages, limitations of solar PV technology

3 SWOT analysis of PV technology

4 Types of solar cell, wafer based silicon cell

5 Thin film amorphous silicon cell

6 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 connections of cell
12 Parallel connections of cell
13 Mismatch in cell, fill factor
14 Effect of solar radiation and temperature on power output of module
15 I-V and power curve of module
16 Balance of Solar PV system: introduction to batteries
17 Battery classification, lead acid battery, nicked cadmium battery
18 Comparison of batteries
19 Battery parameters
20 Charge controller: types of charge controller
21 Function of charge controller
22 PWM type charge controller
23 MPPT type charge controller
24 Converters: DC to DC converter
25 DC to AC type converter
26 Application of Solar PV system. solar home lighting system
27 Solar lantern
28 Solar fencing
29 Solar street light
30 Solar water pumping system
31 Roof top solar photovoltaic power plant
32 Smart grid technology

Practical

1 Study of V-I characteristics of solar PV system
2 Smart grid technology
3 Application of smart grid technology
4 Manufacturing technique of solar array
5 Converters DC to DC
6 Converters DC to DC
7 Converters DC to AC
8 Converters DC to AC

9 Domestic solar lighting system

10 Various solar module technologies

11 Various solar module technologies

12 Study of MAP

13 Safe measurement of PV modules electrical characteristics

14 Safe measurement of PV modules electrical characteristics

15 Commissioning of complete solar PV system

16 Practical Examination

References

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Department of Physical Education

COCA 101 **NSS - Non Credit Course** **1 (0+1)**

Course outlines

Practical

Orientation of students towards national problems; Study of the philosophy of N.S.S., fundamental rights, directive principles of state policy, socio-economic structure of Indian society, population and five year plans; Functional literacy: Non-formal education of rural youth, eradication of social evil, awareness programmes, consumer awareness, highlights of the Consumer Act, environment enrichment and conservation, health, family welfare and nutrition; Right to information act. Aims and objectives of NSS: NSS logo, motto etc. Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, Village adoption.

Objectives

To impart knowledge on NSS programme and motto to students, Village adoption, to make to understand the community, identify the needs and problems of community and to develop a sense of social and civil responsibility, utilize the knowledge for finding practical solution for community problems, to develop the capacity to meet the emergency and national disasters as well as to practice nation integration and social harmony.

Lecture

Practical

1 Orientation of Students towards National problems; Campus Cleaning

2 To make aware of Fundamental rights; Campus cleaning

3 Introduction and importance of NSS; Campus Cleaning

4 Study of Activities for improving the Social status of women; Campus cleaning

5 To make aware of Socio – economic structure of Indian society; Campus cleaning

6 Study of population and five year plans; Campus Cleaning

7 Study of activities during the emergencies

8 To make aware of Non-formal education of rural youth; Campus Cleaning

9 Study of Educational Culture; Campus cleaning

10 To undergo first – Aid training; Campus cleaning

11 Study of consumer awareness; Campus Cleaning

12 Study of activities directed by the Central & State Government; Campus Cleaning

13 Study of Environment enrichment; Campus Cleaning

14 Study of Environment Conservation and health; Campus cleaning

15 Study of family welfare and Nutrition; Campus cleaning

16 To aware of Right to Information Act; Campus cleaning

COCA 102 Physical Education and Yoga Practice 1 (0+1)

Course outlines

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; Circuit training, interval training, far trek 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.

Objectives

To create the awareness on different aspects of health and fitness, learn good health habits. To acquire knowledge on common communicable disease, acquire the knowledge of games and yoga asanas. To exercise for good health and physique moment of body through different positions, postures, poses and games.

Lecture

Practical

1 Introduction of Physical Education – Objectives - development and importance

2 Study of Physical Training and Health

3 To make aware of Exercises for good posture

4 Study of exercises to develop Physical fitness & growth

5 To know the terms, Flexibility – Components – Speed – Strength – endurance applicable to physical education

6 Power - Agility – Co-ordination and balance

7 Test and measurement in Physical Education – Physical fitness and Motor fitness test

8 Study of first – Aid training and how to prevent from sports and games injuries

9 Study of weight training – aerobic and non-aerobic exercises

10 To learn circuit training – interval training – far trek training

11 To improve the leadership qualities in Physical Education

12 Importance of Asanas – free exercises and yoga

13 To know recreation – promoting recreation – camping and re-recreation

14 Organization of tournaments – Inter Class – Inter collegiate- South zone - National and Inter- national events organization

15 Drawing of fixtures – Rules and regulations – Coaching

16 Fundamental skill development of major games – Coaching and techniques development of Athletic events

Note: 1) Compulsory Uniform: Half pants, T Shirts, Shoes and socks all white (Girls to wear white T Shirt and Track pants)

2) The games mentioned in the practical may inter change depending on the season and facilities.

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