CATALOGUE OF
DIPLOMA IN AGRICULTURAL ENGINEERING

POLYTECHNIC OF AGRICULTURAL ENGINEERING

Unit-wise Syllabus and Lecture Outlines

ANGRAU

ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
LAM, GUNTUR - 522 034

Dean of Agricultural Engineering and Technology addressing the faculty during Brain Storming Workshop on PAE Syllabus Review and Process of Conduct of Examinations on 14-06-2019

Participants of the workshop on PAE Syllabus Review and Preparation of Study Materials on 08-08-2019

DETAILED LECTURE OUTLINES

(Unit wise course contents – Diploma in Agricultural Engineering)

Polytechnic of Agricultural Engineering

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ANGRAU

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FOREWORD

Acharya N.G. Ranga Agricultural University is offering several undergraduate and postgraduate courses in the faculty of Agriculture, Agricultural Engineering and Technology and Community Sciences. Besides, a three-year Diploma in Agricultural Engineering is being offered in English Medium through 2 constituent and 15 affiliated Polytechnics of Agricultural Engineering spread across the state of Andhra Pradesh.

After the assessment of all the 17 Polytechnics of Agricultural Engineering by the Dean of Agricultural Engineering and Technology, a status report of Polytechnics function was prepared and it has been decided to involve the faculty members of Acharya N. G. Ranga Agricultural University in refining the syllabus, lecture outlines, and curriculum according to unit system to benefit the student fraternity who opted to Polytechnic of Agricultural Engineering course. Accordingly, more than 50 members of the faculty of Agricultural Engineering and Technology and Agriculture were involved, discussed several times and prepared this document for the standard operational procedure for teaching this course in all campuses.

I am happy to learn that the course catalogue will help the faculty working in the Polytechnics of Agricultural Engineering to teach in a better manner as prescribed in standard procedures in all the polytechnics and also help the students to study the course in a systematic manner to face the practical classes and examinations.

The leadership and untiring efforts of Dr. K. Yella Reddy, Dean of Agricultural Engineering in organizing several workshops for bringing this Course Catalogue as well as preparation of different study materials and standard procedures for the benefit of Polytechnic Agricultural Engineering students is highly appreciated. I extend my hearty congratulations and best wishes to all the contributors to this Course Catalogue.

Date : 06-11-2019
Place: Guntur

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(V. Damodara Naidu)

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ANGRAU

PREFACE

Diploma in Agricultural Engineering is a three year (6 semester) course offered by Acharya N. G. Ranga Agricultural University in 2 constituent and 15 affiliated polytechnics across the state with the aim of training the students to provide primary level technical manpower in the areas of Farm Machinery and Power Engineering, Process and Food Engineering and Soil and Water Conservation Engineering including Micro- irrigation. From time to time the syllabus and course content has been modified and updated to meet the academic standards and field requirements.

Based on my visits to all 17 Polytechnics of Agricultural Engineering and discussions held with the students and staff it was felt necessary to revamp the syllabus and course content to improve the performance of the polytechnics. Accordingly, it was decided to revise the course contents and develop study material for all the courses offered. With the support of the identified Faculty members of Agricultural Engineering and Technology and Faculty of Agriculture, unit-wise lecture outline of all the courses were prepared and accordingly the study materials have been updated for the benefit of polytechnic students. I am confident that the updated lecture outlines and study materials will enable them in better and in-depth understanding of the disciplines and result in good performance in the examinations, as well as to develop the expertise in the desired areas.

I express my gratitude to Dr. V. Damodara Naidu, Hon'ble Vice – Chancellor, Acharya N. G. Ranga Agricultural University, Guntur for his encouragement in preparing this Course Catalogue. I appreciate the efforts of Dr. M. Raghu Babu, Professor (Academic) and Dr. B. Mukunda Rao, Professor (Polytechnics) in compiling the contents into very useful format. I congratulate all the faculty members involved in the preparation of this course catalogue and the study material for all courses. Also, I wish good luck to all the students of Polytechnics of Agricultural Engineering for their bright future.

(K. Yella Reddy)

Date: 06 -11-2019
Place: Guntur

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POLYTECHNIC OF AGRICULTURAL ENGINEERING

Diploma in Agricultural Engineering
YEAR WISE & SEMESTER WISE DISTRIBUTION OF COURSES

w.e.f. 2019-20

S. No.	Course No.	Title of the course	Credits
		I Year Semester – I	
1	DAE 151	Fundamental of Mathematics	3(2+1)
2	DAE 152	Engineering Physics	2(1+1)
3	DAE 153	Engineering Chemistry	2(1+1)
4	DAE 141	Workshop Technology – I	3(1+2)
5	DAE 154	Communication Skills	1(0+1)
6	DAE 142	Engineering Drawing	2(0+2)
7	DAE 155	Principles and Practices of Crop Production	3(1+2)
	COCA100	NCC	1(0+1)NC
		Total	**16 (6+10)**
		I Year Semester – II	
1	DAE 143	Computer Applications	2(1+1)
2	DAE 156	Engineering Mathematics – I	2(1+1)
3	DAE 144	Principles of Fluid Mechanics	2(1+1)
4	DAE 157	Principles and Practices of Soil Science and Management	3(2+1)
5	DAE 145	Workshop Technology – II	3(1+2)
6	DAE 146	Applied Electronics and Instrumentation	2(1+1)
7	DAE 147	Surveying and levelling – I	3(1+2)
8	DAE 131	Wells and Pumps Operation and Maintenance	1 (0+1)
	COCA200	Physical Education	1(0+1)NC
		Total	**18 (8+10)**
		II Year Semester – I	
1	DAE 251	Engineering Mathematics – II	2(1+1)
2	DAE 241	Engineering Mechanics & Materials Testing	2(1+1)
3	DAE 221	Engineering Properties and Processing of Seeds	3(1+2)
4	DAE 222	Agricultural Process Engineering – I	3(1+2)
5	DAE 231	Soil and Water Conservation Engineering & Practices	2(1+1)
6	DAE 211	Agricultural Implements	3(2+1)
7	DAE 242	Surveying and Levelling – II	3(1+2)
	COCA300	NSS	1(0+1)NC
		Total	**18 (8+10)**
		II Year Semester – II	
1	DAE 243	Principles of Thermodynamics and Heat Engines	2(1+1)
2	DAE 212	Agricultural Machinery	3(2+1)
3	DAE 232	On-Farm Irrigation and Drainage Practices	3(1+2)
4	DAE 244	Strength of Materials	2(1+1)
5	DAE 223	Agricultural Process Engineering - II	2(1+1)
6	DAE 245	Principles of Electrical Engineering & Farm Electricity	2(1+1)
7	DAE 233	Micro Irrigation Principles and Practices	3(1+2)
		Total	**17 (8+9)**
		III Year Semester - I	
1	DAE 313	Farm Power, Solar, Wind and Bio-Energy	2(1+1)
2	DAE 341	Estimating and Costing of Farm Buildings and Structures	2(1+1)
3	DAE 351	Principles of Agricultural Economics and Business Management	2(1+1)
4	DAE 331	Hydrology and Management of Watersheds	2(1+1)
5	DAE 321	Greenhouse Technology	2(1+1)
6	DAE 311	Tractor systems, Operation and Maintenance	3(2+1)
7	DAE 312	Operation and Maintenance of Farm Machinery	2(0+2)
8	DAE 352	Agricultural Engineering Extension Methods	1(0+1)
9	DAE 353	Introduction to Environmental Science and Disaster Management	1(1+0)
		Total	**17 (8+9)**
		III Year Semester – II	
1	DAE 361	Participatory Technology Training Program (2months)	12(0+12)
2	DAE 362	Project Work (2 months)	5(0+5)
		Total	**17(0+17)**
		Grand Total	**103 (38+65)**

POLYTECHNIC OF AGRICULTURAL ENGINEERING
Diploma in Agricultural Engineering

Department-Wise Distribution of Credit Load & Courses

S.No.	Course No.	Title of the course	Credits
1. Farm Machinery & Power Engineering (5)			
1	DAE 211	Agricultural Implements	3 (2+1)
2	DAE 212	Agricultural Machinery	3 (2+1)
3	DAE 311	Tractor systems, Operation and Maintenance	3 (2+1)
4	DAE 312	Operation and Maintenance of Farm Machinery	2 (0+2)
5	DAE 313	Farm Power, Solar, Wind and Bio-Energy	2 (1+1)
2. Processing & Food Engineering (4)			
1	DAE 221	Engineering Properties and Processing of Seeds	3 (1+2)
2	DAE 222	Agricultural Process Engineering – I	3 (1+2)
3	DAE 223	Agricultural Process Engineering - II	2 (1+1)
4	DAE 321	Greenhouse Technology	2 (1+1)
3. Soil and Water Engineering (5)			
1	DAE 131	Wells and Pumps Operation and Maintenance	1 (0+1)
2	DAE 231	Soil and Water Conservation Engineering & Practices	2 (1+1)
3	DAE 232	On-Farm Irrigation and Drainage Practices	3 (1+2)
4	DAE 233	Micro Irrigation Principles and Practices	3 (1+2)
5	DAE 331	Hydrology and Management of Watersheds	2 (1+1)
4. Basic Engineering (13)			
1	DAE 141	Workshop Technology – I	3 (1+2)
2	DAE 142	Engineering Drawing	2 (0+2)
3	DAE 143	Computer Applications	2 (1+1)
4	DAE 144	Principles of Fluid Mechanics	2 (1+1)
5	DAE 145	Workshop Technology – II	3 (1+2)
6	DAE 146	Applied Electronics and Instrumentation	2 (1+1)
7	DAE 147	Surveying and leveling – I	3 (1+2)
8	DAE 241	Engineering Mechanics & Materials Testing	2 (1+1)
9	DAE 242	Surveying and Leveling – II	3 (1+2)
10	DAE 243	Principles of Thermodynamics and Heat Engines	2 (1+1)
11	DAE 244	Strength of Materials	2 (1+1)
12	DAE 245	Principles of Electrical Engineering & Farm Electricity	2 (1+1)
13	DAE 341	Estimating and Costing of Farm Buildings and Structures	2 (1+1)
15. Applied Sciences (11)			
1	DAE 151	Fundamentals of Mathematics	3 (2+1)
2	DAE 152	Engineering Physics	2 (1+1)
3	DAE 153	Engineering Chemistry	2 (1+1)
4	DAE 154	Communication Skills	1 (0+1)
5	DAE 155	Principles and Practices of Crop Production	3 (1+2)
6	DAE 156	Engineering Mathematics – I	2 (1+1)
7	DAE 157	Principles and Practices of Soil Science and Management	3 (2+1)
8	DAE 251	Engineering Mathematics – II	2 (1+1)
9	DAE 351	Principles of Agricultural Economics and Business Management	2 (1+1)

10	DAE 352	Agricultural Engineering Extension Methods	1 (0+1)
11	DAE 353	Introduction to Environmental Science and Disaster Management	1 (1+0)
Rural and Entrepreneurship Awareness Development Yojana (Student READY)			
1	DAE 361	Participatory Technology Training Program (2 months)	12 (0+12)
2	DAE 362	Project Work (2 months)	5 (0+5)
Physical Education – Non-Credit Courses			
1	COCA100	NCC	1 (0+1) NC
2	COCA200	Physical Education	1 (0+1) NC
3	COCA300	NSS	1 (0+1) NC

DAE 131 **Wells and Pumps Operation and Maintenance** **1 (0+1)**

Objective To acquire the knowledge on different irrigation wells and their maintenance. Further students get through knowledge on various pump sets (CP, SP, Solar) Operation, construction, maintenance and installation with due importance to find out the troubles and cost of operations.

Practical's

1 Study of open well
2 Study of tube well
3 Maintenance of open well and tube well
4 Tutorial problems on cost analysis of pumping system
5 Visit to open well
6 Visit to tube /bore well
7 Study of different well development methods
8 Study of centrifugal pump(CP) construction and operation
9 Study of centrifugal pump troubles, remedies and maintenance
10 Study of submersible pump(SP) construction and operation
11 Study of submersible pump troubles, remedies and maintenance
12 Dismantling, assembling and installation of centrifugal pump
13 Dismantling, assembling and installation of submersible pump
14 Visit to pump sets servicing workshop
15 Study of solar pump set
16 Brief review of practical's carried out

References

1 Water, Well & Pump Engineering, Michael A. M. and Khepar S. D., 1989. Tata Mc Graw Hill Publishing Co Ltd, New Delhi.
2 Irrigation Theory and Practice, Michael A.M., 2008. Vikas Publishing House Pvt Ltd, New Delhi.

DAE 141 **Workshop Technology - I** **3 (1+2)**

Objective To impart basic knowledge of various tools and their usage in different section of manufacturing such as carpentry, fitting and sheet metal works. Hands on training in workshop build the knowledge and confidence, which aims the students to enhance their manufacturing skills.

Theory

Lecture No.	**Contents**	**References**
	Unit 1	
1	Introduction to workshop technology - manufacturing process - classification of manufacturing process - basic workshop process – carpentry marking tools	1, 2

2	Carpentry measuring tools- cutting tools- planning tools - boring tools - striking tools - holding tools- miscellaneous tools	1, 2
	Unit 2	
3	Carpentry processes - marking- sawing - planning - chiselling- boring- grooving - rebating - moulding and carpentry joints	1, 2, 3
4	Wood working machines- wood turning lathe - band saw - wood planer - grinder - carpentry and pattern making layout	1, 2, 3
	Unit 3	
5	Fitting - introduction - holding tools- types of vices - care of vices - striking tools - types of hammers- classification	1, 2
6	Cutting tools – types of chisels – classification – scrapers – hacksaw – power hack saw	1, 2
	Unit 4	
7	Drill bits- types, advantages of twist drills - reamer bits- parts of reamer bit – hand reamers – machine reamers and its classification; Taps- parts of taps, types; Dies – die stocks - tap wrenches	1
8	Die stock: marking tools – surface plate - angle plate- v-block – scriber – simple scribing block universal surface gauge – punches	1
	Unit 5	
9	Fitting- checking and measuring tools – transfer callipers- combination set – bevel protractor- reading of bevel protractor – sine bar - engineer's parallels	1, 2
10	Gauges- slip, feeler, angle, radius, template, screw pitch, telescopic, plate, ring, plug, snap gauges	1, 2
	Unit 6	
11	Vernier callipers- reading of vernier- vernier height gauge, vernier depth gauge; Micrometer – inside micrometer- outside micrometer	1, 2, 3
12	Reading of micrometer – depth micrometer - vernier micrometer – screw thread micrometer - fitting operations and layout of fitting shop	1, 2, 3
	Unit 7	
13	Sheet metal work – introduction – metals used – measuring tools – dividers- trammel points- punches – chisels – hammers- mallets	1, 2
14	Snips or shears – types Stakes – types – pliers – groovers- rivet set – soldering iron	1, 2
	Unit 8	
15	Sheet metal operations – shearing – bending, drawing- squeezing– sheet metal joints- hem joints - seam joints	1, 2
16	Fastening methods- riveting- soldering- brazing- spot wedging machine - laying out a pattern and sheet metal shop; Safety precautions in sheet metal work- layout of sheet metal work	1, 2

Practical's

1	Practice on planning, sawing and chiseling
2	Preparation of a half lap joint
3	Preparation of a dovetail joint

4	Preparation of a mortise joint
5	Preparation of a drill joint
6	Preparation of a 20cm x 15cm teakwood switch board with hinges and bottom hook
7	Preparation of a 20cm x 15cm teakwood switch board with hinges and bottom hook
8	Fix the laminate sheet to the above box and cut suitable holes to mount one flush type switch, socket
9	Job works on sawing, filing and right angle fitting of MS Flat
10	Job works on sawing, filing and right angle fitting of MS Flat
11	Job works on sawing, filing and right angle fitting of MS Flat
12	Job works on sawing, filing and right angle fitting of MS Flat
13	Practical in more complex fitting job (V- Fitting)
14	Practical in more complex fitting job (V- Fitting)
15	Job works on drawing, punching, bending, and shaping
16	Job works on drawing, punching, bending, and shaping
17	Cut a metal conduit, GI pipe and solid using hack saw
18	Thread cutting GI pipe, metal conduit and solid rod using die set
19	Internal thread cutting using tap set reamers
20	Internal thread cutting using tap set reamers
21	Prepare a job and make a lap weld
22	Prepare a job and make a lap weld
23	Prepare a job and make a spot weld
24	Prepare a job and make a spot weld
25	Prepare a job and make a seam weld
26	Prepare a job and make a butt weld
27	Prepare a job and make a butt weld
28	Prepare a job and make a T- welded joint and finish it using grinder
29	Jobs on ARC welding
30	Jobs on Oxyacetylene gas welding
31	Jobs on Oxyacetylene gas welding
32	Brief review of practical's carried out

References

1. Workshop Technology, Anitha M., Falcon Publishers, Hyderabad.
2. Workshop Technology, Pakirappa and Kumar V. N., 2010. Radiant Publishing House, Hyderabad.
3. Elements of Workshop Technology Vol. I, Raghuwansi, B. S., 2003. Dhanpat Rai and Co. Pvt. Ltd, Nai Sarak, New Delhi.

DAE 142 **Engineering Drawing** **2 (0+2)**

Objective To impart knowledge and skills on visualization of buildings, objects, equipment, machines through drawings, plans, sectional views, isometric views and orthographic projections.

Practical's

1	Understanding the importance of engineering drawing in diploma course
2	Use of engineering drawing instruments
3	Free hand lettering and numbers as per BSI – writing practice
4	Understand dimensioning– practice
5	Dimensioning a given drawing using standard notations and desired system of dimensioning
6	Dimensioning standard features and applying necessary rules
7	Identifying the departures if any made in the given dimensioned drawing with references to SP-46-1988
8	Dividing a given line into desired number of equal parts internally
9	Drawing tangent lines and arcs
10	Construction of a hexagon from the given data
11	Construction of ellipse by concentric circles method and using a paper trammel
12	Construction of parabola, rectangular hyperbola involute, cycloid and helix from given data
13	Projection of a point with respect to references planes (HP & VP)
14	Projections of straight lines with respect to two references planes
15	Projections of perpendicular planes
16	Principles of orthographic projection with simple sketches
17	Orthographic view of an object, from given pictorial drawing
18	Minimum number of views needed to represent a given object fully
19	Draw the section plane for a given component to reveal maximum information and sectional view
20	Appling conventional practices and identify the parts, which should not be shown in section while drawing sectional views
21	Applying principles of hatching
22	Drawing simple sections (full, half, revolved and removed part) for a range of simple engineering objects
23	Auxiliary views of a given engineering component to indicate the true shape and size of component
24	Drawing the auxiliary views of a given engineering drawing
25	Objects, draw their orthographic views
26	Isometric projections for the given orthographic drawings
27	Oblique drawing cavalier, cabinet of simple engineering objects from the given data
28	Draw the correct pictorial views from a set of orthographic drawings
29	The need for preparing developing drawing
30	Development of simple engineering objects using parallel line and radial line method

31	Development of surface of engineering components like trays, funnel, 900 elbow and rectangular duct
32	Brief review of practical's carried out

References

1 Engineering Drawing, Manchu S. R., Falcon Publishers, Koti, Hyderabad.

2 Engineering Drawing, Subbarayudu M., Falcon Publishers, Koti, Hyderabad.

DAE 143 Computer Applications 2 (1+1)

Objective The course is designed to aim at imparting a basic level appreciation programmed for the students. After completing the course, the incumbent can know the use of computer in the areas of hardware and software of both application as well as operating systems and know to perform various functions/tasks using MS-Office package (Word, Excel and Power Point), viewing information on Internet (WWW), composing and sending mails. This allows everyone to be a part of computer users list by making them digitally literate and maintain their small account using the computers and enjoy in the world of information technology.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Introduction to computer uses, advantages and disadvantages - definition of computer, common uses of computer; Advantages- multitasking, speed, cost and storage of huge amount of data, accuracy, data security; Disadvantages - virus and hacking attacks, online cyber crimes, reduction in employment opportunity	1, 2
2	Study of computer system components and their uses, measurement of memory - block diagram of computer, memory and types of memories, memory measurement	2
	Unit 2	
3	Introduction to Operating Systems - definition and types of software, definition of operating system, types of operating systems; Windows Operating System and its types	2
4	Utilities of Desktop - task bar, mouse right click utilities on desktop; Opening programs from start menu- searching of files, copy, paste, move operations with short-cut keys	2
	Unit 3	
5	Installation of MS Office, Introduction to MS Word – opening and creation of document, formatting the document, page setup with short-cut keys	1
6	Use of different facilities from the menu bars of MS Word - spell checking, change of fonts, size of fonts with short-cut keys - different font styles – bold, italic and underline with short-cut keys	1
	Unit 4	
7	Tables in MS Word - creation of tables, formatting, change of rows and columns, width and height with short-cut keys- merging of cells, word wrap in different directions, borders with short -cut keys	1

8	Use of mail merge and printing a document - creating mail merge in MS – Word and uses - printing a document and properties with short-cut keys	1
	Unit 5	
9	Introduction to MS Excel - opening a work book / work sheet, creating a rows and columns in a work sheet, a cell merging with short-cut keys - entering data in cells, changing the type of data using tool bar options with short-cut keys	1
10	Sorting of data – ascending, descending, usage of formulas – applying to specific cells, simple mathematical calculations with short-cut keys	1
	Unit 6	
11	Creation of charts and different types of charts - pie chart, column chart, line chart, Bar chart, area chart, scatter chart, other chart types with short-cut keys- formatting a chart with short-cut keys	1
12	Printing a worksheet - page setup – properties, page breaks with short-cut keys	1
	Unit 7	
13	Introduction to Power Point - creation of slides, templates and animation effects – properties with short-cut keys	1
14	Back up of data to CD/DVD using a Reader/Writer software – Wizard and Nero	1
	Unit 8	
15	Introduction to Internet – World Wide Web (WWW) - Invention of WWW, website, web browser, opening of a home page, different search engines – Yahoo, Google and Baidu	2
16	Creation of user accounts – e mail (electronic mail) ID - usage of e mail account – performing different operations- creation of mail, upload attachments, sending a mail, downloading attachments, searching a mail, create a labels – properties / settings with short-cut keys	2

Practical's

1	Installation of latest Windows Operating System	2
2	Practices on a utilities of desktop	2
3	Installation of latest MS Office package	1
4	Practices on MS Word- text/font with different formats	1
5	Creating Tables in MS Word in different Formats	1
6	Creating Mail Merge in MS Word, printing documents in different formats	1
7	Practices on MS Excel with basic operations	1
8	Practices on MS Excel- working with data of different formats	1
9	Practices on MS Excel- sorting of data and usage of different formulas	1
10	Creating a different type of charts in MS Excel	1
11	Practices on MS Excel: Setting and printing worksheets of different types	1
12	Creating and working on Power Point in different possible ways	1
13	Creating and working on back – up data to CD/DVD – read / write data with different ways	1

14	Practices and working on Internet (WWW)- usage of browsers, search engines	2
15	Creating and practicing on E Mail (electronic mail)	2
16	Brief review of practical's carried out	-

References

1 First look 2007 MS office , Katherine Murray, Microsoft Press, A Division of Microsoft Corporation One Microsoft Way, Redmond, Washington 98052-6399.

2 Windows 7 for Seniors for Dummies, Mark Justice Hinton ,Wiley Publishing, Inc 111 River Street, Hoboken, NJ 07030-5774.

DAE 144 Principles of Fluid Mechanics 2 (1+1)

Objective 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.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Fluid – definitions – classification – properties, units and dimensions	1, 2
2	Fluid pressure – introduction - measurement of fluid pressure - Piezometer tube – Manometry - types of manometers	1, 2
3	Mechanical gauges - Bourdon's tube pressure gauge - Diaphragm pressure gauge - Dead weight pressure gauge	1, 2
	Unit 2	
4	Kinematics of fluid flow-Introduction-continuity of fluid flow – types of flow lines	1, 2
5	Dynamics of fluid flow- various forms of energy in fluid flow, frictional loss, general equation	1, 2
	Unit 3	
6	Bernoulli's theorem, Euler's equation of motion	1, 2
7	Practical applications of Bernoulli's theorem, venturimeter, pitot tube, orifice meter	1, 2
	Unit 4	
8	Flow through orifices (measurement of discharge) – types of orifices, Jet of water, vena, contracta, hydraulic coefficients	1, 2
9	Experimental method for hydraulic coefficients, discharge through a rectangular orifice	1, 2
	Unit 5	
10	Flow through mouth pieces - types of mouth pieces - loss of head of a liquid flowing in a pipe, discharge through a mouth piece	1, 3
11	Flow over notches - types of notches, discharge over a rectangular notch and triangular notch	1, 3
	Unit 6	
12	Flow over weirs - types of weirs, discharge over a weir, Francis's formula for discharge over a rectangular weir	2, 3

13	Bazin's formula for discharge over a rectangular weir, velocity of approach, discharge over a trapezoidal weir	2, 3
	Unit 7	
14	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	2, 3
	Unit 8	
15	Flow through open channels -Manning's formula and Chezy's formula	2, 3
16	Pumps – classification of pumps – principle of working of different pumps	2, 4, 5

Practical's

1	Numericals on properties of fluid
2	Numericals on measurement of pressure
3	Experimental determination of pressure with Manometer
4	Verification of Bernoulli's theorem
5	Measurement of discharge with a venturimeter
6	Measurement of velocity with pitot tube
7	Numericals on Bernoulli's theorem and continuity equation
8	Determination of coefficient of discharge of rectangular weir
9	Determination of coefficient of discharge of triangular weir
10	Determination of coefficient of discharge of trapezoidal weir
11	Determination of hydraulic coefficient of orifices
12	Experiment on broad crested weir
13	Numericals on weirs
14	Determination of head losses in pipes
15	Numericals on flow through pipes and open channels
16	Brief review of practical's carried out

References

1. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines, Khurmi, R. S., 1970. S Chand & Company Limited, New Delhi.
2. Fluid Mechanics and Hydraulic Machines, Bansal R. K., Laxmi Publications (P) Ltd, New Delhi.
3. Hydraulics and Fluid Mechanics, Modi P. M. and Seth S. M., 1973. Standard Book House, Delhi.
4. A Text Book of Hydraulics, Reya V. V. and Rao DS. P., Radiant Publishing House Book house, Koti, Hyderabad.
5. Hydraulics and Fluid Power Systems, Appa Rao G., Radiant Publishing House, Koti, Hyderabad.

DAE 145 **Workshop Technology – II** **3 (1+2)**

Objective To impart basic knowledge of machine tools and their usage in different section of manufacturing such as foundry, drilling and lathe machines. The ability to work skilfully with hand can be developed more readily and accurately, when the work to be performed in a workshop is understood in both theoretically and Practically. Hands on training in workshop build the knowledge and confidence, which aids the students to enhance their manufacturing skills during the period of their study.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Introduction to foundry - Advantages and disadvantages of foundry – process of producing castings, hand moulding tools	1, 2
2	Pattern making, pattern materials, types of patterns, pattern allowances and colour codes for patterns	1, 2
	Unit 2	
3	Sequence in pattern making, classification of moulding sand – Natural moulding sands, synthetic sands and special sands	1, 2
4	Sand binders – clay type binders, organic type binders, inorganic type binders and sand additives	1, 2
	Unit 3	
5	Properties of moulding sand – porosity, flowability, collapsibility, adhesiveness, cohesiveness, refractoriness, cores and core requirements	1, 2
6	Core sands, types of cores, core making Moulding procedure, Moulding processes, Bench moulding, floor moulding, pit moulding and machine moulding	1, 2
	Unit 4	
7	Green sand moulding, dry sand moulding, skin dried sand moulding, loam moulding and cement Bonded moulding	1, 2
8	Carbon dioxide moulding, shell moulding, ceramic moulding, centrifugal and investment casting; Defects in castings and safety precautions in foundry shop	1, 2
	Unit 5	
9	Introduction to drilling; Working principle of drill, types of drilling machines – sensitive drilling machine and radial drilling machine	1, 2
10	Specification of drilling machine, work holding devices- drill press vice, parallels, V-blocks, angle plate, T-bolts, straps and step blocks	1, 2
	Unit 6	
11	Tool holding devices – drill chucks, drilling machine spindle, sleeves and sockets types of drills – flat drill, straight fluted drill, twist drill, core drill, oil tube drill and center drill	1, 2
12	Twist drill nomenclature- drilling machine operations – drilling, reaming, boring counter boring, counter sinking, tapping, spot facing and trepanning	1, 2

Unit 7

13	Introduction to lathe- classification of lathe machines- functions of lathe- types of lathes	3
14	Constructions details of lathe, description and functions of lathe parts	3

Unit 8

15	Accessories and attachments- mandrels- rests- catch plate – lathe dogs	3
16	Operations performed on lathe machine and cutting tools in centre lathes	3

Practical's

1	Demonstration on casting equipment and tools
2	Demonstration on casting equipment and tools
3	Demonstration on pattern making
4	Demonstration on pattern making
5	Mould making using one piece pattern
6	Mould making using one piece pattern
7	Mould making using two pieces pattern
8	Mould making using two pieces pattern
9	Plane turning on lathe machine
10	Plane turning on lathe machine
11	Step turning on lathe machine
12	Step turning on lathe machine
13	Taper turning on lathe machine
14	Taper turning on lathe machine
15	Knurling operation on lathe
16	Knurling operation on lathe
17	Drilling on lathe machine
18	Boring on lathe machine
19	External thread cutting on lathe machine
20	External thread cutting on lathe machine
21	Internal thread cutting on lathe machine
22	Internal thread cutting on lathe machine
23	Working on sensitive drilling machine
24	Working on sensitive drilling machine
25	Working on drilling machine reaming, boring and counter boring
26	Working on drilling machine counter shrinking, tapping, spot facing and trepanning
27	Working on power hack saw
28	Working on power hack saw
29	Working on circular saw (cold saw)
30	Visiting of local farm implements manufacturing units
31	Visiting of a moulding unit
32	Brief review of practical's carried out

References

1 Workshop Technology, Anitha M., Falcon Publishers, Koti, Hyderabad.

2 Workshop Technology, Pakirappa and Kumar V. N., 2010. Radiant Publishing House, Hyderabad.

3 Elements of Workshop Technology Vol. II., Hajra Choudhury S. K., Hajra Choudhury, A. K., and Nirjhar Roy, 2010. Media Promoters and Publishers Pvt. Ltd, Mumbai.

DAE 146 Applied Electronics and Instrumentation 2 (1+1)

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

Theory

Lecture No.	Contents	References
	Unit 1	
1	Classification of metals, conductors, semiconductors, intrinsic semiconductor and extrinsic semiconductor (N Type and P Type)	1, 5
2	P-n junction diode, formation of p-n junction, forward biased and reverse biased, (V-I) characteristics	1, 5
	Unit 2	
3	Clipping circuits, positive clipper, biased and combination clipper with circuit diagram	1, 5
4	Application of junction diode as half wave and full wave rectifier with circuit diagram, showing the input and output wave form	1, 5
	Unit 3	
5	Junction transistor emitter, base, collector - PNP, NPN Transistor, operating point, dc load line analysis	1, 5
6	Transistor as an amplifier in CB mode, CE mode, CC mode with circuit diagrams, input and output characteristics	1, 5
	Unit 4	
7	Filter circuits, action of choke input filter, CLC or π filter with circuit diagram	1, 5
8	Coupling of amplifiers, gain frequency response curve R-C coupled amplifier circuit diagram frequency response curve advantages, disadvantages	1, 5
	Unit 5	
9	Transistor biasing – essentials of transistor biasing, stability factor, voltage divider bias method	1, 5
10	Hybrid parameters, hybrid equivalent circuit of (CE) amplifier	1, 5
	Unit 6	
11	Oscillator principle, explanation of phase shift oscillator with circuit diagram and draw backs	1, 5
12	Operational amplifier – characteristics of an ideal OP-AMP, operational amplifier stages	1, 5

Unit 7

13	OP-AMP as integrator, comparator, adder	3, 5
14	Regulated dc power supply, voltage regulation, zener diode voltage regulator	1, 5

Unit 8

15	Boolean algebra - OR laws AND laws NOT laws, commutative law, associative law, distributive law and absorptive law	4, 5
16	Thermocouple – See beck effect, peltier effect, Thomson effect and Resistance thermometer	5, 6

Practical's

1	Study of the specifications and pin configurations of IC
2	To study and use of AF/RF signal generator
3	To study cathode ray oscilloscope
4	To study the regulated power supply
5	To plot the V-I characteristics of PN junction diode
6	To obtain the regulation characteristics of half wave rectifier
7	To obtain the regulation characteristics of full wave rectifier
8	To construct the diode clipper for clipping of input wave form at different levels and observe the output in the CRO
9	To draw the frequency response of RC coupled amplifier and calculate the band width
10	To obtain the regulator characteristics of a zener diode and at supply side and load side
11	To obtain the output the wave form of RC phase shift oscillator
12	To study the operational amplifier as integrator
13	To study the operational amplifier as inverter
14	To study the operational amplifier as summer
15	To draw the transistor (CE& CB) characteristics
16	Brief review of practical's carried out

References

1	Principles of Electronics, Mehta V. K., S Chand and Co, New Delhi.
2	Measurement of Electronics and Electronic Instrumentation, Shancy A. K., Khanna Publications, New Delhi.
3	Integrated Electronics, Roy Chowdary, John Wiley International, New Delhi.
4	Digital Electronics, Kumar Anand A., PHI.
5	Electronic Devices and Circuits, Gupta Sanjeev and Santhosh Gupta, Danapath Rai Publications.
6	Electronics Measurements and Instrumentation, Rajendra Prasad, Khanna Publications, New Delhi.

DAE 147 Surveying and Levelling – I 3 (1+2)

Objective To enable the students to acquire skills in the measurement of field dimensions, preparation of plans or layouts and estimate their areas of regular and irregular fields. Further to enable the students to take observations using levelling instrument and calculate the reduced levels for preparation of contour maps of agricultural fields.

Lecture No.	Contents	References
	Unit 1	
1	Concept of Surveying – Definition, objectives of surveying, purpose of surveying and uses of surveying- methods of locating a point- fundamental principles of surveying- linear and angular measurements- basic units of linear and angular measurements; Instruments used for taking linear and angular measurements; Scale and Representative Fraction (RF) plan and map duties of surveyor	1, 2, 3 and 4
2	Primary division of surveying, classification of survey based on the different criteria such as the nature of the field survey, the object of survey, methods employed in survey and the instruments employed	1, 2, 3 and 4
	Unit 2	
3	Chain Surveying- Purpose and principle of chain survey; Instruments or equipment used in chain survey and their functions, chains – metric chain, guntur's chain, revenue chain, engineer's chain and steel band tapes – cloth or linen tape, metallic tape, steel tape, Invar tape and synthetic tape; Ranging rods, offset rods, laths, whites, arrows, pegs, plumb bob, cross staff, optical square- folding and unfolding of chain	1, 2, 3 and 4
4	Method of chaining – method of chaining on level ground, errors in chaining – compensating errors and cumulative errors, mistakes in chaining, correction of distances and area due to incorrect length of chain or tape, problems on correction of distances and areas; Different operations in chain surveying; Definition and methods of ranging-direct ranging- ranging by eye, ranging by line ranger and indirect ranging	1, 2, 3 and 4
	Unit 3	
5	Chaining on sloping ground – direct and indirect methods, selection of survey stations chain triangulation – principle of chain triangulation, field work procedure - reconnaissance survey, marking stations, index sketch, References sketch, running survey lines, baseline, check line and tie line; Cross staff survey - principle, setting out right angles with open cross staff and optical square, measurement of offsets and calculation of area	1, 2, 3 and 4
6	Recording field notes – method of booking observations in field observation book, conventional symbols, obstacles in chaining and methods to overcome obstacles; Calculations of areas using different methods like average ordinate method, trapezoidal method and Simpson's rule; Problems on calculation of areas of irregularly bounded fields	1, 2, 3 and 4
	Unit 4	
7	Compass Surveying- introduction- purpose and principle of compass survey- description, working and uses of prismatic compass, concept of meridian, types of meridians - true meridian, magnetic meridian and arbitrary meridian; Designation of bearings - whole circle bearing, quadrantal bearing - conversion of whole circle bearing to quadrantal bearing	1, 2, 3 and 4

8	Compass Survey – types of compass traversing - traversing using prismatic compass - closed traverse and open traverse- local attraction-detection of local attraction, application of correction for local attraction; Instruments used in compass survey, temporary adjustments of prismatic compass and field procedure of compass survey	1, 2, 3 and 4
	Unit 5	
9	Declination- isogonic charts and agonic charts, variations in magnetic declination – secular variations, annual variations, diurnal variations and irregular variations; Conversion of magnetic bearings to true bearings; Problems on calculation of included angles	1, 2, 3 and 4
10	Plotting of compass surveying- closing error and adjustments by Bowditch method(graphical method), errors in compass surveying - instrumental error, error due to manipulation and sighting and error due to external influences – precautions	1, 2, 3 and 4
	Unit 6	
11	Levelling- definition and terminology connected with levelling such as datum, elevation or reduced level, line of collimation, axis of the telescope, height of instrument, change point, parallax, station, back sight, fore sight, intermediate sight; Bench mark and its types, description of dumpy level and levelling staff and types of levelling staves, operations involved in levelling - temporary adjustments of a dumpy level, field procedure in levelling, level field note book, recording procedure in level field note book	1, 2, 3 and 4
12	Determination of reduced levels by height of instrument or height of collimation method and rise and fall method, arithmetic check for both methods – comparison and problems	1, 2, 3 and 4
	Unit 7	
13	Errors in levelling - personal, instrumental and natural causes; Curvature and Refraction – precautions in levelling	1, 2, 3 and 4
14	Classification of levelling – simple levelling, differential levelling, check levelling, Profile levelling, reciprocal levelling, barometric levelling, hypsometry and trigonometrical levelling; Detailed description of reciprocal levelling and profile levelling(longitudinal sections) – problems on reciprocal levelling and profile levelling	1, 2, 3 and 4
	Unit 8	
15	Contouring – definition and objectives, uses and characteristics of contours, contour line, contour interval and horizontal equivalent, methods of contouring – direct and indirect methods - grid method and cross sections method; Interpolation of contours by arithmetical calculation and graphical methods; Tracing contour gradient -use of contour maps	1, 2, 3 and 4
16	Minor instruments: Abney level –Uses, working principle and constructional features; Electronic planimeter- uses, working principle, constructional features and applications of electronic planimeter; Pentagraph – uses, working principle, constructional features and procedure to reduce a drawing	1, 2, 3 and 4

Practical's

1	Acquaintance with the survey instruments
2	Study of a plan and map
3	Folding, unfolding of the chain and ranging a chain line
4	Measurement of distances by pace method
5	Chain triangulation survey
6	Plotting of chain triangulation
7	Chain triangulation by offset method
8	Plotting of chain triangulation by offset method
9	Cross staff survey
10	Plotting of cross staff survey
11	Tutorial classes dealing the problems on errors in chaining
12	Tutorial classes dealing the problems on errors in chaining
13	Different methods for dealing with obstacles in chaining operation
14	Study of planimeter and computation of areas using planimeter
15	Study of planimeter and computation of areas using planimeter
16	Computation of areas of irregular fields by different methods like average ordinate, trapezoidal and Simpson's rule
17	Study of prismatic compass and surveyor compass and accessories
18	Compass survey by intersection method
19	Plotting of compass survey by intersection method
20	Compass survey by traverse method
21	Plotting of compass survey by traverse method
22	Tutorial classes on bearings and its related problems
23	Tutorial classes on bearings and its related problems
24	Acquaintance with levelling equipment
25	Temporary adjustments for a levelling instrument
26	Booking of level staff readings
27	Tutorial class on reduction of levels by HI method and by rise and fall method
28	Tutorial class on reduction of levels by HI method and by rise and fall method
29	Study of Survey of India topo sheet
30	Grid survey
31	Study of contour map
32	Brief review of practical's carried out

References

1	Surveying and Levelling Vol.- I, Kanetkar T. P. and Kulkarni S. V, Pune Vidyarthi Griha Prakashan, Sadasivpeth, Pune.
2	Surveying and Levelling Vol.- I, Punmia B. C., Laxmi Publications (Pvt.) Ltd, Golden house, Daryaganj, New Delhi.
3	Surveying-I, Nagesh Kumar G., Falcon Publishers, Koti, Hyderabad.
4	Text book of Surveying- I, Sarma H. K., Radiant Publishing House, Koti, Hyderabad.

DAE 151 **Fundamentals of Mathematics** **3 (2+1)**

Objective To aware of the fundamental mathematics and basic application for solving the engineering and other related problems.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Define the logarithm and list its properties- natural and common logarithms- explaining the meaning of e and exponential functions	1, 2
2	Partial fractions - rational, proper and improper fractions of polynomials, resolving rational fractions	1, 2
3	Partial fractions covering the types mentioned below: i) $\frac{f(x)}{(x+a)(x+b)(x+c)}$ ii) $\frac{f(x)}{(x+a)^2(x+b)(x+c)}$ iii) $\frac{f(x)}{(x^2+a)(x+b)}$ iv) $\frac{f(x)}{(x+a)(x^2+b)^2}$	1, 2
4	Matrices and determinants- definition of matrix, types of matrix-examples – algebra of matrices-equality of two matrices, sum, scalar multiplication and product of matrices	1, 2
	Unit 2	
5	Transpose of matrix-Symmetric, skew symmetric matrices- minor and cofactor of an element	1, 2
6	Determinant of a square matrix(Upto 3 x 3) - Laplace's expansion	1, 2
7	Properties of determinants- singular and non-singular matrices- adjoint and multiplicative inverse of a square matrix	1, 2
8	Rank of a matrix (determinant method)	1, 2
	Unit 3	
9	System of linear equations in 3 variables - solutions by Cramer's rule	1, 2
10	Matrix inversion method-examples- elementary row operations on matrices	1, 2
11	Gauss-Jordan method to solve a system of equations	1, 2
12	Definition of permutations and combinations and their relationships- Binomial expansion- Finding of general term and middle term	1, 2
13	Quadratic equations	1, 2
	Unit 4	
14	Trigonometric Ratios : Definition of trigonometric ratios of any angle, values of trigonometric ratios at specified values, periodicity of trigonometric functions	1, 2
15	Compound Angles: formulas of sin (A±B), cos (A±B), tan (A±B), cot (A±B), and related identities with problems	1, 2
16	Multiple and Sub-multiple angles: Trigonometric ratios of multiple angles 2A, 3A, and sub-multiple angle A/2 with problems	1, 2
17	Transformations of products into sums of differences and vice versa-simple problems	1, 2

	Unit 5	
18	Inverse Trigonometric functions: Definition, domains and ranges-basic properties-problems	1, 2
19	Hyperbolic Functions : Definitions of hyperbolic functions, identities of hyperbolic functions, inverse hyperbolic functions and expression of inverse hyperbolic functions in terms of logarithms	1, 2
	Unit 6	
20	Concept of limit- definition - properties of limit and standard limits-simple problems	1, 2
21	Continuity of a function at a point- simple examples only	1, 2
22	Concept of derivative – definition (first principle) - different notations-derivatives of elementary functions-problems	1, 2
23	Derivatives of sum, product, quotient, scalar multiplication of functions-problems	1, 2
	Unit 7	
24	Method of differentiation of a function of a function (chain rule)	1, 2
25	Derivatives of inverse trigonometric functions, derivative of a function with respect to another function	1, 2
26	Derivative of parametric functions, derivative of hyperbolic, implicit functions	1, 2
27	The need of taking logarithms for differentiating –with some examples	1, 2
	Unit 8	
28	Higher order derivatives-examples– functions of several variables- partial differentiation, Euler's theorem- simple problems	1, 2, 3
29	Physical applications of the derivative- velocity, acceleration derivative as a rate measure- problems	1, 2, 3
30	Applications of the derivative to find the extreme values- increasing and decreasing functions	1, 2, 3
31	Finding the maxima and minima of simple functions- problems leading to applications of maxima and minima	1, 2, 3
32	Partial differentiation of two variables upto second order only	1, 2, 3

Practical's

1	Problems on logarithms
2	Problems on partial fractions
3	Problems on matrices (using mathematical operations)
4	Problems on determinants, crammer's, Gauss Jordan and Inverse methods
5	Problems on rank of matrices using determinants
6	Problems on compound angels, multiple and sub-multiple angles
7	Problems on trigonometric transformations
8	Problems on inverse trigonometric functions
9	Problems on limits and continuity
10	Problems on differentiation (first principle)
11	Problems on differentiation (product, quotient, chain rule and inverse trigonometric)

12	Problems on differentiation (logarithms, implicit functions and one function with respect to another function)
13	Problems on higher order differentiation
14	Problems on velocity and acceleration
15	Problems on maxima and minima in applications like finding areas, volumes
16	Problems on partial differentiation

References

1. Engineering Mathematics – I, Vishnu Murthy M., Falcon Publications, Koti, Hyderabad.
2. Engineering Mathematics – I, Ramana K. V. and Kusuma K., Falcon Publications, Koti, Hyderabad.
3. Engineering Mathematics – I, Raju M.V. S. L. D. N. and Ramana K. V., VGS Book Links, Vijayawada.

DAE 152 Engineering Physics 2 (1+1)

Objective To give insight to the students about fundamentals of physics, magnetism, motion, electricity and light and their applications.

Theory Lecture No.	Contents	References
	Unit 1	
1	Units and Dimensions: Introduction – physical quantity – fundamental and derived physical quantities- unit fundamentals and derived units – SI units with symbols- rules of writing SI units- advantages- dimensions and dimension formula- principle of homogeneity of dimensions	1, 2
2	Elements of Vectors: Introduction - scalar- vector- definitions- examples- Graphical representation of vectors- types of vectors- addition and subtraction of vectors-representation of vector in space; Resolution of vectors - resultant of the vectors by component method (Parallelogram law of vectors- Triangle Law of vectors to be covered in practical class); Dot product of two vectors - properties – cross product of two vectors – properties	1, 2
	Unit 2	
3	Kinematics Equations of motion in straight line – acceleration due to gravity- expression for max height –time of ascent- time of descent and velocity on reaching the point of projection; Derivation for height of a tower when a body is projected upwardly from the top-projectile motion	1, 2
4	Horizontal projection– derivation for the path of horizontal projection- derivation for maximum height Time of flight and horizontal range maximum range of a projectile in oblique projection- derivation for magnitude and direction of resultant velocity in oblique projection	1, 2
	Unit 3	
5	Friction Introduction: Definition- types of friction- laws of friction (static and kinetic) coefficient of friction – angle of friction with respect to rough horizontal surface- derivations for displacement and time taken to come to rest over a rough horizontal surface-work done by frictional force- Advantage and disadvantages of friction-methods of minimizing friction	1, 2

6	Work-power-energy: Definitions of work- power- energy- concept of power - definition of potential energy- expression for potential energy - definition of kinetic energy- expression for kinetic energy – work energy theorem – law of conservation of energy and its verification in the case of falling body and simple pendulum - conventional and non-conventional energy sources	1, 2
	Unit 4	
7	Simple harmonic motion: Definition- conditions of SHM- equation for SHM as projection of particle executing uniform circular motion- expression for displacement- velocity and acceleration	1, 2
8	Heat and thermodynamics: Introduction - expansion of gases- Boyle's law (its verification in practical class), Charles Law- Absolute scale of temperature - Ideal gas equation- gas constant – universal gas constant - gas equation in terms of density	1, 2
	Unit 5	
9	Difference between r and R-concept of internal energy- external work done by a gas; Isothermal process and Adiabatic process- law of thermo dynamics- specific heats of gas - relation Cp – Cv = R	1, 2
10	Sound introduction – musical sound and noise and difference between them – noise pollution-causes for noise pollution - effects of noise pollution - methods to minimize noise pollution - beats – application; Doppler effect- formula for apparent frequency (a) source in motion- observer at rest (b) observer in motion – source at rest- Applications reverberation- reverberation time echoes	1, 2
	Unit 6	
11	Properties of matter: Introduction to elasticity – definitions of stress-strain - Hooke's Law- types of stress –types of strain - types of moduli of elasticity i. Definition of surface tension – explanation of surface tension with the help of molecular theory-definition of angle of contact and capillarity- formula for surface tension – determination of surface tension by capillary rise method ii. Definition of viscosity - coefficient of viscosity-Newton's formula for viscous force- effect of temperature on viscosity Poiseuille's equation and determination of coefficient of viscosity by Poiseuille's method	1, 2
12	Electricity and Magnetism introduction to electricity- Ohm's law and explanation - specific resistance- conductance- Kirchhoff's Laws and explanation- Wheatstone's bridge - meter bridge and its use to determine specific resistance	1, 2
	Unit 7	
13	Magnetism coulomb's inverse square law, magnetic field and magnetic lines of force, magnetic induction field strength – units, moment of couple on bar magnet placed in a uniform magnetic field- derivation for magnetic induction field strength at a point on the axial line	1, 2

14	Modern physics photo-electric effect- Einstein's photo electric equation - laws of photoelectric effect working of photoelectric cell - photomultiplier – applications of photoelectric effect	1, 2
	Unit 8	
15	Recapitulation of refraction of light and its law's - critical angle- total internal reflection-principle and working of optical fiber- m types of optical fibers- applications of optical fibers	1, 2
16	Super conductor-super conductivity – properties of super conductors – applications of super conductors	1, 2

Practical's

1	Determination of volume of a cylindrical body with vernier caliper
2	Determination of thickness of the given body with screw gauge
3	Determination of the weight of given body corrected up to milligram using physical balance
4	To determine thickness and radius of curvature of convex or concave lense with spherometer
5	To verify parallelogram law of forces and triangular law of forces
6	To verify the laws of simple pendulum and to determine the acceleration due to gravity
7	To determine the velocity of sound in air using resonance apparatus at room temperature
8	To find the focal length and power of convex lense by U-V method
9	To determine the refractive index of a given solid using Travelling microscope
10	To find out the surface tension of water by capillary rise method
11	Determine the coefficient of viscosity of a liquid by poiseullies method
12	To verify Boyle's law in air using Boyle's apparatus
13	To determine resistance and specific resistance of the material(wire) using meter bridge
14	To map magnetic lines of force around a bar magnet
15	To map magnetic lines of force around a bar magnet
16	Brief review of practical's carried out

References

1	Engineering Physics, M. Raghavendra, Falcon Publications, Koti, Hyderabad.
2	Engineering Physics, S. B. Singh, Falcon Publications, Koti, Hyderabad.

DAE 153 Engineering Chemistry 2 (1+1)

Objective To study the chemical aspects of engineering materials and processes such as ionization, corrosion, lubricants and polymers, which provide a good insight to the students for engineering applications in the field of agricultural engineering and industry.

Theory Lecture No.	**Contents**	**References**
	Unit 1	
1	Fundamentals of chemistry – fundamental particles of atom - atomic number, mass number	1, 3
2	Chemical bonds - types of bonds – properties of ionic, covalent and coordinate compounds	1, 3

	Unit 2	
3	Fundamentals of organic chemistry- features of organic compounds- difference between organic and inorganic compounds	2, 3
4	Sources of organic compounds-role of organic compounds in agriculture	2, 3
	Unit 3	
5	Common ion effect- applications- solubility product-Ionization- factors influencing ionization- ionic equilibrium- Ostwald's dilution law- factors affecting- limitations	1
	Unit 4	
6	Electrolysis- electrolytes- classification of electrolytes	1
7	Mechanism of electrolysis- Ohm's law- conductance of electrolytes	1
8	Measurement of electrolyte conductance-measurement of specific conductivity by wheat stone bridge	1
	Unit 5	
9	Water- sources- impurities- hardness of water- types of hardness- degree of hardness- units of hardness- disadvantages of hard water for industrial and agricultural use	1
10	Water softening methods- Zeolite process- Ion exchange or deionization process-mixed bed deionizer–advantages – limitations	1
	Unit 6	
11	Lubricants - functions - mechanisms of lubrication - classification of the lubricants	1
12	Important properties of lubricants	1
	Unit 7	
13	Polymers- basic concepts of polymerization- plastics- characteristics of plastics- advantages and disadvantages of plastics	1
14	Important of plastics- polythene- PVC- Bakelite	1
	Unit 8	
15	Fuel- definition- classification- characteristics of good fuel- petroleum-gaseous fuels	1
16	Rubbers- compounding of rubber- vulcanization of rubber- silicone rubber- properties and uses	1

Practical's

1	Glassware and chemicals used in laboratory
2	Care, maintenance, do's and don'ts in laboratory
3	Types of expressing solution concentration- equivalent weight, normality, molarity, %(per cent) and ppm
4	Preparation of standard solution (normal, molar & ppm solutions)
5	Standardization of H_2SO_4
6	Collection of irrigation water sample for quality analysis
7	Determination of pH and EC of irrigation water
8	Determination of CO_3^{-2} and HCO_3in irrigation water

9 Standardization of NO_3

10 Determination of chlorides in irrigation water

11 Determination of Na content in irrigation water

12 Standardization of EDTA

13 Determination of total hardness (Ca + Mg) in water

14 Irrigation water quality- Rating for EC, SAR and RSC

15 Interpretation of irrigation water quality for agriculture

16 Saponification value of oil/ fat

References

1 Engineering Chemistry, Jain P. L. and Jain M., 1994. Dhanpat Rai Publishing Company Pvt Ltd, Delhi.

2 Principles of Chemistry, Joseph H. Roe., 1967. The CV Mosby Company, Saint Louis.

3 Intermediate Chemistry Vol. 1& 2. Telugu Academy, Board of Intermediate Education, Andhra Pradesh, Hyderabad.

4 Engineering Chemistry & Environmental studies, Venkatanarayana G., Falcon Publications, Koti, Hyderabad.

DAE 154 COMMUNICATION SKILLS 1 (0+1)

Objective By the end of this course to enable the students to

- Familiarize with the process of communication, non - verbal communication and language, commonly used antonyms and synonyms and terminology of agriculture in English.
- Know and acquire the skills of usage of grammar, parts of speech, types of verbs, articles, tenses, kinds and types of sentences, propositions and usage of dictionary.
- Know and acquire the skills of using of active voice, passive voice, direct and indirect speech, dialogue delivery, letter writing, report writing and office correspondence.

Practical's

1 Communication - meaning, definition, types, communication process /cycle, elements, purposes and barriers of professional communication

2 Non- verbal communication - meaning, non- verbal communication vs body language, methods and media of non- verbal communications; Kinesics - non verbal cues such as body movements, postures – standing and sitting, gestures – emblems, illustrators and adaptors; hand, handshakes, finger, arm and leg movements; Occulesics - eye contact and facial expressions; Tactilics- bodily contact and touching with hands; Chronemics; Proxemics - intimate, personal, social and public zone; paralanguage/paralinguistics, artifacts and physical appearance

3 Language - tool of communication; characteristics of language - artificial, restricted, abstract, arbitrary, creative, redundant and recursive

4 Antonyms and Synonyms - Important with their meanings

5 Terminology of agriculture in English

6 Grammar - meaning, definition and parts of speech - noun, pronoun, adjective, verb, adverb, proposition, connectives / conjunctions and modals; interjections

7	Verbs - meaning and types: main verb and auxiliary verbs - primary (be form) and modal auxiliary; Prepositions - important prepositions in daily English conversation
8	Article: meaning and types: a) definite b) indefinite articles and their usage in a sentence
9	The tenses - meaning and types - present tense, past tense, future tense and present perfect tense; subject - verb agreement
10	Sentence - meaning, elements, kinds - declarative, interrogative, exclamatory and imperative; types - simple, compound and complex
11	Dictionary: use of dictionary and effective utilization
12	Active voice and passive voice with examples; Direct and indirect speech with examples
13	Essay writing or creative writing
14	Dialogue delivery: conversation dialogues
15	Letter writing - personal, official, covering letters, and preparation of bio - data - resume or curriculum - vitae and job application letter
16	Report writing and office correspondence

References

1. Andhra Pradesh State Board of Technical Education & Training (SBTET) **Enhancing English and Employability Skills** -1 Hyderabad: English Faculty of Government Polytechnics.
2. Andhra Pradesh State Board of Technical Education & Training (SBTET) **Enhancing English and Employability Skills** - 2 Hyderabad: English Faculty of Government Polytechnics.
3. Andhra Pradesh State Board of Technical Education & Training (SBTET) **Enhancing English and Employability Skills** - 3 Hyderabad: English Faculty of Government Polytechnics.
4. Andhra Pradesh State Board of Technical Education & Training (SBTET) **Enhancing English and Employability Skills** - 4 Hyderabad: English Faculty of Government Polytechnics.
5. Balasubrahmanian M., 1990. Business Communication New Delhi: 4863/ 2B, Bharatram Road, 24, Daryaganj.
6. Bovee, Courtland, Thill John V. and Chaturvedi, Mukesh, 2009. Dorling Kindersley (India) Pvt Ltd 7th Floor, Knowledge Boulevard, Noida, U P.
7. Globereena Technologies Pvt Ltd, 2005. Professional Communication, Hyderabad: F – 28, Madhura Nagar, Yusafguda.
8. Kumar, Sanjay and Latha, Pushpa, 2012. Communication Skills, New Delhi: Oxford India Press, YMCA Library Building, Jai Singh Marg.
9. Lesikar, Reymond, Flatley Marie E Rentz, Karthryn and pande, Neerja, 2012. Business Communication - Making Connections in a Digital world Tata McGraw - Hill Publishing Company Limited, 7, West Patel Nagar.
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11. Murphy, Herta A, Hildebrandt, Herbert and Thomas, Jane P., 2011. Effective Business Communication New Delhi: Tata McGraw - Hill Publishing Company Limited, 7, West Patel Nagar.
12. Raman, Meenakshi and Sharma, Sangeetha, 2011. **Communication Skills** New Delhi: Oxford India Press, YMCA Library Building, Jai Singh Marg.

13 Raman, Meenakshi and Singh, Prakash, 2012. **Business Communication** New Delhi: Oxford India Press, YMCA Library Building, Jai Singh Marg.

14 Rao, C R and Neelam, 2018. **Employability Skills** Kakinada: Srinivasa Enterprises, Technical and Allied Book Promoters.

15 Rizvi, M. Ashraf, 2005. **Effective Technical Communication** New Delhi: Tata McGraw - Hill Publishing Company Limited, 7, West Patel Nagar.

16 Sambaiah M., 2017. Technical English New Delhi: Wiley India Pvt Ltd, 36/ 7, Ansari road, Daryaganj.

17 Sen and Leena, 2005. Communication Skills New Delhi: Printice Hall of India Private Limited, M -97, Connaugh Circus.

18 Sengupta and Sailesh, 2011. Business Managerial Communication New Delhi: PHI Learning Private Limited, M - 97, Connaught Circus.

19 Sikkim Manipal University, 2007. **Communication Skills - Information Technology** Gangtok: Directorate of Distance Education, Sikkim Manipal University, 5th mile, Taclong.

20 Technical Publishers, 2018. Communication Skills and Soft Skills (Question Bank) Guntur: Technical Publishers, 6th lane, Main Road, Nehru Nagar.

DAE 155 Principles and Practices of Crop Production 3 (1+2)

Objective To enable the student to understand the farming principles to grow agricultural and orchard crops and farming practices for higher crop production.

Theory Lecture No.	**Contents**	**References**
	Unit 1	
1	Development of agriculture in India- history- ICAR, national and international agricultural research institutes Indian agriculture – land and water resources	2
2	Agro climatic zones of Andhra Pradesh: Major crops- soils-weather - growing period - ANGRAU research stations	3
	Unit 2	
3	Monsoons – seasons - seasonal crops- influence of weather on crop growth and development; Classification of field crops according to botany, season, ontogeny, economical, monocots and dicots	1, 2
4	Tillage- tilth- objectives of tillage- , characteristics of good seed bed, and effect of tillage on soil properties; Types of tillage – primary and secondary - seed bed preparation – puddling	1
	Unit 3	
5	Seeds: Seed material -characteristics of seed/ seed material Sowing: methods of sowing - time of sowing - depth of sowing- seed rate and spacing of important crops	1, 3
6	Crop stand establishment: Factors affecting crop stand establishment – plant population: optimum plant population and environment	1
	Unit 4	
7	Soil fertility and productivity: Soil fertility losses – maintenance of soil fertility- soil organic matter	5

8	Manures: Bulky organic manures- concentrated organic manures – soil amendments - biofertilizers	1, 5
	Unit 5	
9	Mineral nutrition: essential elements- deficiency symptoms- toxicity symptoms – correction measures	1, 5
10	Fertilizers: classification- nitrogenous, phosphatic and potassic fertilizers- fertilizer dose- methods of fertilizer application- time of fertilizer application- compatibility of fertilizers	1, 5
	Unit 6	
11	Irrigation water management: Basics on soil plant and water relationship - soil water- soil moisture constants- soil moisture estimation - critical periods of irrigation- water requirements of crops- methods of irrigation - water productivity	1, 2
12	Weed: Definition - weed problems- weed classification- crop weed competition- critical periods of crop weed competition Weed management- chemical & non chemical (cultural, physical, mechanical and biological) control methods	1, 2
	Unit 7	
13	Dryland Agriculture: Dryland farming and rainfed farming- problems of crop production in dry farming – soil moisture conservation practices - watershed management – aims and objectives	1
14	Cropping systems: terminology- inter cropping- sequential cropping - crop rotation – navadhanya concepts	1
	Unit 8	
15	Harvesting: storage and post-harvest processing (rice, groundnut and sugarcane)	1
16	Sustainable agriculture and organic farming: Definition- concept, meaning and components of sustainable agriculture and organic farming	1, 2

Practical's

1	Visit to Agricultural Information Centre
2	Identification of crops, seeds, manures, oil seed cakes and fertilizers
3	Study of tillage implements
4	Practice of primary tillage
5	Practice of secondary tillage
6	Practice of seed bed preparation
7	Preparation of rice/vegetable nurseries
8	Selection of seed, Seed treatment and germination test
9	Study of methods of sowing
10	Practice of sowing of ID crops
11	Nursery pulling in rice (or any operation related to rice)
12	Transplanting of rice (or any operation related to rice)
13	Thinning and gap filling
14	Study of inter-cultivation implements
15	Practice of inter-cultivation

16	Identification of weeds
17	Study of different weed control methods
18	Practice of hand weeding
19	Practice of spraying of herbicides
20	Use of bio control agents and IWM
21	Identification of plant diseases
22	Spraying of fungicides
23	Study of different irrigation methods
24	Study of sprinkler and drip irrigation methods
25	Identification of beneficial and harmful insects and IPM
26	Study of maturity symptoms in crops
27	Harvesting of crops
28	Threshing and winnowing
29	Visit to near by bio-fertilizer unit/organic farm
30	Study of farm implements and farm machinery (RARS/Agril College farm/ARS)
31	Visit to seed production and processing Centre
32	Visit to Regional Agricultural Research Station (RARS)

References

1. Principles of Agronomy , Yellamanda Reddy T. and Sankara Reddi G.H., 2016. Kalyani Publishers.
2. Principles of Agronomy, Reddy S. R., 2019. S R Kalyani Publishers, Ludhiana.
3. Vyavasaya Panchamgam, 2018-19 An ANGRAU Publication.
4. Soil Science: An introduction, 2015 Indian Society of Soil Science (ISSS).

DAE 156 Engineering Mathematics - I 2 (1+1)

Objective To import the knowledge on engineering calculus and statistics to enable the student to apply for solving the engineering problems in the courses of agricultural, civil and mechanical Engineering.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Integration regarded as anti-derivative- indefinite integral of standard functions	1, 2
2	Properties of indefinite integral	1, 2
3	Integration by substitution	1, 2
	Unit 2	
4	Integrals of the form $\sin^m\theta \cos^n\theta$ where m and n are positive integers Integrals of tan x, cot x, sec x, cosec x and powers of tan x, sec x by substitution	1, 2

5	Evaluation of integrals which are reducible to the following forms: $\frac{1}{a^2+x^2}$, $\frac{1}{a^2-x^2}$, $\frac{1}{x^2-a^2}$, $\frac{1}{\sqrt{a^2+x^2}}$, $\frac{1}{\sqrt{a^2-x^2}}$, $\frac{1}{\sqrt{x^2-a^2}}$	1, 2
6	Evaluation of integrals which are reducible to the following forms: $\sqrt{x^2-b^2}$, $\sqrt{a^2+b^2}$, $\sqrt{a^2-x^2}$	1, 2
	Unit 3	
7	Evaluation of integrals which are reducible to the following forms: $\sqrt{x^2-b^2}$, $\sqrt{a^2+b^2}$, $\sqrt{a^2-x^2}$	1, 2
8	Integration by decomposition of the integrand into simple rational, algebraic functions. Integration by parts and Bermoulli's rule	1, 2
	Unit 4	
9	Evaluate integrals using integration by parts with examples	1, 2
10	Definite integration	1, 2
	Unit 5	
11	Vector algebra- definition of vector- types- additions- subtraction of vectors- properties of addition and subtraction Scalar product of vectors- properties – angle between two vectors – unit vector perpendicular to two vectors	3, 5
	Unit 6	
12	Vector calculus - differentiation of vectors, Vector differential operator del, gradient of a scalar point function; Divergence and curl of a vector point function (solenoidal and irrotational vectors)	3, 5
13	Line integral - work done by force	3, 5
	Unit 7	
14	Introduction to Statistics- definition – frequency table (grouped and ungrouped data)	4
15	Measures of central tendency - mean, median and mode (Direct method and deviation Method) – ideal measures - merits and demerits	4
	Unit 8	
16	Measures of dispersion- range, quartile deviation, mean deviation, standard deviation and coefficient of variation – merits and demerits	4

Practical's

1	Problems on integration (simple problems)
2	Problems on integration by substitution and product rule
3	Problems on evaluate the integrals of the form $\int \sin^m\theta \cos^n\theta \, d\theta$
4	Problems on integrals of tan x, cot x, sec x, cosec x and powers of tan x, sec x by substitution
5	Problems on standard integrals of the function of the types $\frac{1}{a^2+x^2}$, $\frac{1}{a^2-x^2}$, $\frac{1}{x^2-a^2}$

6	Problems on standard integrals of the function of the types $\frac{1}{\sqrt{a^2+x^2}}$, $\frac{1}{\sqrt{a^2-x^2}}$, $\frac{1}{\sqrt{x^2-a^2}}$
7	Problems on Evaluation of integrals which are reducible to the following forms: $\sqrt{x^2-b^2}$, $\sqrt{a^2+b^2}$, $\sqrt{a^2-x^2}$
8	Problems on integration by parts
9	Problems on definite integral (simple problems)
10	Problems on gradient of scalar point function
11	Problems on divergence and curl of a point function
12	Problems on solenoidal and irrotational vectors
13	Problems on work done by force
14	Problems on mean, median and mode (grouped and ungrouped data)
15	Problems on range, quartile deviation, mean deviation (grouped and ungrouped data)
16	Problems on standard deviation and coefficient of deviation (grouped and ungrouped data)

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1	Engineering Mathematics- II, Vishnu Murthy M., Falcon's Publications , Koti, Hyderabad.
2	Engineering Mathematics-II, Ramana K. V. and Kusuma K., Falcon Publications, Koti, Hyderabad.
3	Engineering Mathematics- II, Raju M. V. S. L. D. N. and Ramana K. V., VGS Book Links, Vijayawada.
4	Fundamental Mathematical Statistics, Gupta S. C. and Kapoor V. K., S Chand & sons, New Delhi.
5	Engineering Mathematics-III, Iyengar T. K. V., S Chand Publications.

DAE 157 Principles and Practices of Soil Science and Management 3 (2+1)

Objective To impart knowledge on soil genesis, soil forming process, structure, soil organic matter, soil chemical properties, which give a comprehensive idea to students how to design farm implements in relation to soils and also how to treat the soil for soil health and structural improvement, soil conservation, irrigation and drainage applications.

Theory Lecture No.	Contents	References
	Unit 1	
1	Introduction- spheres of earth-soil components- soil as three phase system- mineral matter, organic matter, water and air- branches of soil science	All
2	Definition of soil- soil profile- description of a theoretical soil profile- difference between surface soil and sub surface soil	2, 3
	Unit 2	
3	Rocks- definition- classification- igneous rocks- sedimentary rocks- metamorphic rocks	1, 2
4	Minerals- definition- classification based on origin, quantity, specific gravity and chemical composition	1, 2

	Unit 3	
5	Weathering- types of weathering- physical and chemical weathering processes	1, 2
6	Biological weathering- parent materials- classification based on their mode of transport	1, 2
7	Soil formation- soil forming factors- active and passive factors- their role in soil formation	1, 2
8	Basic soil forming or fundamental processes- eluviation, illuviation, humification	1, 2
9	Specific pedogenic processes- calcification, podzolization, laterization, salinization, alkalization, pedoturbation	1, 2
	Unit 4	
10	Soil solids classification- properties of sand, silt, clay- textural diagram	1, 2
11	Soil texture- mechanical analysis- importance of soil texture	1, 2
12	Soil structure- definition- classification based on type- class and grades- importance of soil structure- aggregation	1, 2
13	Bulk density- particle density- factors and importance- porosity- calculations	1, 2
14	Soil consistency- definition- Atterberg's limits of soil consistency- importance of soil consistency- workability of soils	1, 2
	Unit 5	
15	Soil water- field capacity, wilting point and available water	1, 2
16	Soil moisture potential- Soil moisture constants and determination of soil moisture content	1, 2
17	Soil water movement- saturated and unsaturated flow- Darcy's law and Poiseuille's law	1, 2
18	Infiltration- importance- percolation and permeability	1, 2
19	Soil mulch - definition- importance- stages of evaporation- optimum mulching time	1, 2
	Unit 6	
20	Soil air- composition of soil air and their importance	1, 2
21	ODR- management of soil air	1, 2
22	Soil temperature- factors influencing soil temperature- management of soil temperature	1, 2
23	Soil colour - Munsell colour chart- importance of soil color	1, 2
24	Soil colloids- general properties of soil colloids	1, 2
25	Ion exchange in soils- cation exchange and anion exchange- cation exchange capacity, base saturation- calculations of CEC, and base saturation	1, 2
	Unit 7	
26	Soil biology – types of organisms in soil- benefits of soil organisms- harmful activities of soil organisms	1, 2
27	Soil organic matter- mineralization and immobilization	1, 2
28	Humus- importance of soil organic matter- C:N ratio and significance	1, 2

Unit 8

29	Problem soils: Saline soils- causes for formation and reclamation of saline soils	1, 2
30	Alkaline soils- causes for formation and reclamation of alkaline soils	1, 2
31	Acid soils- causes of soil acidity and reclamation of acid soils	1, 2
32	Physical problems of soils and their management	1, 2

Practical's

1	Collection and processing of soil sample
2	Determination of soil pH and EC
3	Determination of organic carbon content of soil
4	Determination of gypsum requirement of sodic soils
5	Determination of lime requirement of acid soils
6	Determination of mechanical composition of soil by Boycous hydrometer method
7	Determination of soil texture by feel method
8	Determination of bulk density of soil
9	Determination of particle density of soil
10	Determination of maximum water holding capacity of soil using keen cups
11	Determination of moisture content by gravimetric method
12	Determination of soil colour using Munsell colour chart
13	Determination of infiltration rate using double ring infiltrometer
14	Determination of soil strength using cone penetrometer
15	Aggregate analysis by wet sieving method
16	Determination of soil temperature by using soil thermometer

References

1. Text book of Soil Science, Biswas T. D. and Mukherjee S. K., 1987. Tata McGraw-Hill Publisher Co Ltd, New Delhi.
2. Fundamentals of Soil Science, Indian Society of Soil Science, 1998. IARI, New Delhi.
3. Introductory Soil Science, Dilip Kumar Das,2004. Kalyani publisher, New Delhi.
4. Nature and properties of soil Science, Brady Nyle C. and Ray R. Well., 2002. Person Education Inc, New Delhi.

DAE 211 Agricultural Implements 3 (2+1)

Objective Primary and secondary tillage implements along with planting and fertilizing implements will be studied to create awareness to the diploma students on the farm implements used in rural areas and their operational mechanism.

Theory Lecture No.	**Contents**	**References**
	Unit 1	
1	Tillage – definition, objectives of tillage; Classification and types of tillage; primary tillage; Secondary tillage	1, 2
2	Primary tillage Implements-classification of primary tillage implements; Indigenous ploughs – parts of indigenous plough	1, 2

3	Animal drawn Implements: Mould board plough, ridger ploughs and chisel ploughs	1, 2
4	Tractor drawn Implements: Mould board plough, disc plough, chiesel plough, subsoiler and rotary plough	1, 2
	Unit 2	
5	Mould board plough: Components of MB plough; MB Plough accessories, adjustment of MB plough; Animal drawn mould board plough – parts and constructional details; Types of MB ploughs	1, 2
6	Disc plough- types of disc ploughs- standard disc plough- vertical disc plough; Terms related to disc plough; Advantages and disadvantages of disc plough	1, 2
7	Ploughing of land: Important terms related to ploughing of land– methods of ploughing – gathering, casting, continuous ploughing, round and round ploughing and one-way ploughing	1, 2
	Unit 3	
8	Terminology related to implements – draft, unit draft, side draft, centre of power, centre of resistance, pull, line of pull, field capacity, field efficiency, soil inversion and soil pulverisation	1, 2
9	Terminology related to implements – draft, unit draft, side draft, centre of power, centre of resistance, pull, line of pull, field capacity and field efficiency, soil inversion and soil pulverisation	1, 2
10	Secondary tillage implements – classification of harrows	1, 2
11	Animal drawn implements – guntaka(blade harrow), cultivator, spike tooth harrow and spring tyne harrow	1, 2
12	Tractor drawn implements – cultivators – mounted and trailed type cultivators – rigid, spring and duck foot type cultivators	1, 2
	Unit 4	
13	Disc harrow – types and components of disc harrow	1, 2
14	Spike and spring tooth harrows – constructional details of harrows	1, 2
15	Puddlers - constructional details of animal drawn puddlers, power tiller and Tractor cage wheels puddling	1, 2
16	Puddlers - constructional details of animal drawn puddlers, power tiller and Tractor cage wheels puddling	1, 2
	Unit 5	
17	Land development implements such as levellers, bund former, ridger-constructional details of implements	1, 2
18	Green manure trampler – constructional details; Some miscellaneous equipments– shrub cutter, post hole digger, hydro-doger, hydraulic scraper	1, 2
19	Seeding and Fertilizing equipment: Methods of sowing- seed drill-components - classification of animal drawn and tractor drawn seed drills	1, 2
20	Seeding and Fertilizing equipment: Methods of sowing- seed drill-components - classification of animal drawn and tractor drawn seed drills	1, 2

	Unit 6	
21	Seed metering mechanism – types, constructional details; Furrow openers – types of furrow openers	1, 2
22	Seed metering mechanism – types, constructional details; Furrow openers – types of furrow openers	1, 2
23	Animal drawn seed cum fertilizer drills	1, 2
24	Tractor drawn seed cum fertilizer drills	1, 2
	Unit 7	
25	Tractor drawn seed cum fertilizer drills	1, 2
26	Calibration of seed drill, seed-cum-fertilizer drill- seed uniformity tests	1, 2
27	Zero till seed drill, strip-till drill and paddy seeder	1, 2
28	Planters –functions of planter, potato planter, sugarcane planter– construction details, functions and seed metering device in a planter	1, 2
	Unit 8	
29	Inter cultivation implements – manual, bullock and tractor drawn implements	1, 2
30	Wet land and dry land weeders – paddy weeder, hand hoe, spade and wheel hoe	1, 2
31	Harvesting– definition, harvesting implements –principle of cutting of a crop, types of impact cutters; Manual harvesting- sickle	1, 2
32	Harvesting– definition, harvesting implements –principle of cutting of a crop, types of impact cutters; Manual harvesting- sickle	1, 2

Practical's

1	Study the performance of indigenous plough and mould board plough
2	Study the performance of guntaka, cultivator and spike tooth harrow
3	Study the constructional details and performance testing of mould board plough
4	Study the constructional details and performance testing of disc plough
5	Maintenance and adjustments of primary and secondary tillage implements
6	Maintenance of primary and secondary tillage implements
7	Study the constructional details of disc harrows and cultivators
8	Numerical problems related to tillage implements – field capacity, field efficiency and size of tractor
9	Numerical problems related to tillage implements – field capacity, field efficiency and size of tractor
10	Study the constructional details of different types of seed drills
11	Calibration and performance testing of seed cum fertilizer drill
12	Operation and maintenance of seed cum fertilizer drills
13	Numerical problems on seed cum fertilizer drills – calibration, cost of operation and field capacity
14	Study the constructional details and performance testing of paddy seeder
15	Study the constructional details and the performance testing of inter cultivation implements
16	Brief review of practical's carried out

References

1 Elements of Agricultural Engineering, Jagdishwar Sahay, Standard Publishers and distributors, Naisarak, New Delhi.

2 Principles of Agricultural Engineering Vol. I, Michael A. M. and Ojha T. P., Jain Brothers, Ratnada Road, Jodhpur.

3 Agricultural Engineering, Singhal O. P., Aman Publishing House, Meerut.

DAE 212 Agricultural Machinery 3 (2+1)

Objective To enable the students to understand the basic principles of cutting mechanisms and to know the various harvesting machines are available. To know the working and functions of various machine parts of mowers, reapers, windrowers, forage harvesters, threshers, corn harvesters, cotton strippers, cotton pickers, groundnut, potato harvesters, combines, and sugarcane harvesters. Students can also understanding the importance of testing and evaluation of agricultural machines and different standard codes available for testing in India.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Methods of rice plantation- dry planting- wet planting- preparation of field for transplanting	1, 2, 3
2	Nursery preparation machinery- types of nursery raising- tray type, mat type and traditional methods	1, 2, 3
3	Paddy transplanters- types- riding, walking- 4 row, 6 row & 8 row trasplanters- constructional details and working	1, 2, 3
4	Harvesting- history of development- principles of cutting- types of impact cutters- manual harvesting using sickles	1, 2, 3
	Unit 2	
5	Mowers- types- trailed behind tractor mower- integral rear mounted mowers- side or central mounted tractor mower- constructional details and working principles – alignment and aegistration	1, 2, 3 and 4
6	Reapers- types- animal drawn reaper- tractor mounted vertical conveyer reaper- power tiller operated/self-propelled reaper- construction details and working principles- reaper binder working principle- factor affecting the performance of reaper	1, 2, 3 and 4
7	Combine harvester- development history- types- self-propelled combine- pull type combine- functions of combine harvester- advantages and disadvantage	1, 2, 3 and 4
8	Constructional details and working principles of paddy combine harvester :Combine losses- header losses- threshing losses- separation losses- cleaning Losses	1, 2, 3 and 4
	Unit 3	
9	Corn harvesting equipment – development history- types of corn pickers- Snapper, picker- husker and picker- Sheller: Functions- Factors effecting the performance of corn pickers	1, 2, 3 and 4

10	Introduction to root crop harvesting equipments: Groundnut harvesting- groundnut digger- shaker and windrowers	1, 2, 3 and 4
11	Constructional details and working principle of root crop harvesting equipments- diggers- shakers and windrowers	1, 2, 3 and 4
12	Potato harvesting machinery- one row harvester- two row harvesters- introduction to potato combine	1, 2, 3 and 4
	Unit 4	
13	Types of strippers- advantages of strippers over pickers- constructional details- working principles	1, 2, 3 and 4
14	Introduction to cotton harvesting machinery: Cotton pickers- types of cotton strippers-cotton pickers with drum type spindle arrangement-cotton picker with chain belt spindle arrangement- cotton picker with chain belt spindle arrangement – factors effecting the performance of cotton strippers	1, 2, 3 and 4
15	Sugarcane harvesting machinery: Introduction and functions - self- propelled cane harvester	1, 2, 3 and 4
16	Introduction to fruit harvesters- harvesting methods- types of fruit harvesters- manual fruit harvester (Blade type)- manual fruit harvesters (Hold on twist type)- working principle	1, 2, 3 and 4
	Unit 5	
17	Chaff cutters- types on the basis of cutting mechanisms and dropping position of cut chaff- flywheel type chaff cutter- cylinder type chaff cutter– constructional details and working principles	1, 2
18	Power operated chaff cutter- constructional details and working principle	1, 2
19	Terminology related to chaff cutter and related problems	1, 2
20	Plant protection machinery: Sprayers- dusters- applications- functions- desirable quality of sprayer- methods of applying liquid chemicals	1, 2
	Unit 6	
21	Sprayers- classification of sprayers- non-pressure type- low pressure type- high pressure type- basic components of a sprayer	1
22	Manually operated sprayers- types- hand operated sprayer- knapsack sprayer, foot sprayer, rocker sprayer- compression sprayer- hand compression sprayer and atomizer	1
23	Constructional details and working principles of hand operated sprayers	1
24	Power operated sprayers- mist blower- high pressure motorized knapsack sprayer- Constructional details and working principle	1
	Unit 7	
25	Tractor mounted boom sprayer- constructional details and working principle	1
26	Types of nozzles- working principle- constructional details	1
27	Procedure for calibration of sprayers- calibration of nozzle flow rate	1
28	Dusters- principle of dusting- classification of dusters- hand operated dusters- power operated dusters- constructional details and working principle	1

Unit 8

29	Testing programme and procedure for testing of agricultural machinery	1
30	Types of testing system- National testing- Proto type testing	1
31	Regular national tests- confidential tests- commercial tests- batch test, series test, test as per OECD Code	1
32	Test codes of different agricultural implements and machinery	1

Practical's

1	Study the performance constructional details of mowers
2	Study the performance of combine harvester (Paddy)
3	Study the performance of paddy reaper and reaper binder
4	Repair and maintenance of mowers
5	Repair and maintenance of mowers
6	Study the performance of paddy transplanter
7	Operation, repair, maintenance and safety precautions of chaff cutters
8	Study the performance of groundnut digger shaker and windrower
9	Operation, repair, maintenance and safety precaution of sprayer
10	Operation, eepair, maintenance and safety precautions and dusting machinery
11	Tutorial on chaff cutters
12	Tutorial on sprayers and dusters
13	Study the performance and repair and maintenance of post hole digger
14	Operation, repair and maintenance of self-propelled sugar cane harvester
15	Study the performance of groundnut pod stripper and thresher
16	Brief review of practical's carried out

References

1 Elements of Agricultural Engineering Jagdishwar Sahay, 1992. Agro Book Agency, Patna.

2 Principles of Agricultural Engineering-Volume I, Michael A. M. and Ojha T. P., 2008. Jain Brothers, New Delhi.

3 Principles of Farm Machinery Kepner R. A., Roy Bainer and Barger E. L., 1987. CBS Publishers & Distributors, Delhi.

4 Farm Machinery and Equipment, Smith H.P., Tata McGraw-Hill Publishing Co Ltd, New Delhi.

DAE 221 Engineering Properties and Processing of Seeds 3 (1+2)

Objective To enable the students to understand the principles and concepts of various engineering properties of biological materials, to learn the fundamental concepts of the basic properties of food materials and enable them to process, preserve and use them for various applications and to understand different seed processing operations to work in seed industry.

Theory Lecture No.	Contents	References
	Unit 1	
1	Physical properties- physical properties of different food grains - shape and size - criteria for describing shape and size- roundness and sphericity- volume and density	1, 3
2	Specific gravity- bulk density- porosity- surface area- measurement of the same	1, 3
	Unit 2	
3	Rheology- definition- basic concepts- ASTM standard definition of terms- rheological properties - Rheological models: Kelvin and Maxwell models	1, 3
4	Friction – basic concepts; effect of load and sliding velocity; friction in agricultural materials; measurement; rolling resistance; angle of internal friction and angle of repose; Aerodynamics of agricultural products–drag coefficient and terminal velocity	1, 3
	Unit 3	
5	Electrical properties – di-electrical properties- dielectric loss factor- loss tangent - dielectric constant; Thermal properties– specific heat, thermal conductivity and thermal diffusivity	1, 3
6	Application of engineering properties in processing machines and storage structures	1, 3
	Unit 4	
7	Processing of seed – introduction, principles of seed processing- methods of seed drying– sun drying and forced air drying	2, 4
8	Principle of forced air seed drying- properties of air and their effect on seed drying; Control of seed moisture – ventilation- moisture proofing- dehumidification- sealed containers- desiccants	2, 4
	Unit 5	
9	Unit operations of processing and storage– receiving- elevating and conveying equipments- plant design and layout- requirements and economic feasibility of seed processing plant	2, 3, 4
10	Air screen cleaner– seed cleaning equipment and their functions; preparing seed for processing; functions of scalper, debearder, scarifier, huller; seed cleaner and grader	2, 3, 4
	Unit 6	
11	Length separations– disc separator - operation and adjustments- screen cleaners- specific gravity separator- indented cylinder- magnetic and cyclone separator – pneumatic separator- velvet- spiral- disc separator- colour sorter - delinting machines- seed blending	2, 3, 4
12	Seed treatments – methods of seed treatment- seed treating formulations and equipment- seed disinfestations- identification of treated seeds; Packaging– principles, practices and materials- bagging and labelling	2, 4
	Unit 7	
13	Seed storage– purpose and stages of seed storage- storage from harvest until processing- factors affecting seed longevity in storage- general principles of seed storage	2, 4

14	Pest and disease control– constructional features for good seed ware house- other measures for pest and disease control- temperature control- ventilation- insulation- refrigeration	2, 4
	Unit 8	
15	Thumb rules of seed storage – loss of viability in important agricultural and horticultural crops- viability equations and application of nomograph	2, 4
16	Seed certification – definition- control measures;-objectives of seed certification- fundamental concepts of seed certification- seed certification agency- certification of seeds	2, 4

Practical's

1	To find shape of food grains
2	To find size of food grains
3	To determine bulk density of grains
4	To determine angle of repose of grains
5	To determine particle density, true density of solid grains
6	To determine porosity of solid grains
7	Study of Rheological models – Kelvin and Maxwell model
8	Study of Rheological models – Kelvin and Maxwell model
9	Study of creep – stress relaxation
10	To find the coefficients of friction (internal and external) of different crops
11	To find the coefficients of friction (internal and external) of different crops
12	To study separating behavior of grain sample in a vertical wind tunnel
13	To study separating behavior of grain sample in a vertical wind tunnel
14	Field visit to a processing unit
15	To find the thermal conductivity of different powders
16	To find the thermal conductivity of different powders
17	To determine specific heat of some food grains
18	To determine specific heat of some food grains
19	To determine impurities and invisible stress cracks in grains
20	To determine impurities and invisible stress cracks in grains
21	Fractionating aspirators
22	To determine milling quality of paddy
23	Study of air-screen cleaner
24	Study of disc separator and treaters
25	Study of indented cylinder separator
26	Study of specific gravity separator and destoner
27	Study of pneumatic separator
28	Study of roll mill and precision grader
29	Study of spiral separator and inclined draper
30	Study of horizontal disc separator
31	Study of electronic colour sorter
32	Brief review of practical's carried out

References

1 Physical Properties of Plant and Animal Materials, Mohsenin N. N., 1986. Gordon and Breach Science publishers, New York.

2 Seed Processing, Greeg B. R., Law A.G., Virdi S. S. and Balls B. S., National Seed Corporations, US aid Publications.

3 Unit Operations of Agricultural Produce, Sahay K. M. and Singh K. K., Vikas Publishing House Pvt Ltd, New Delhi.

4 Seed Technology, Agarwal R. L., 2016 Oxford and IBH Publishing Co Pvt Ltd, New Delhi.

DAE 222 Agricultural Process Engineering-I 3 (1+2)

Objective To impart the knowledge and skills related to various aspects of crop processing like threshing, winnowing, cleaning, grading, sorting, drying, storage and material handling devices to minimize post harvest losses.

Theory

Lecture No..	Contents	References
	Unit 1	
1	Scope and importance of crop processing – principles and methods of crop processing; post-harvest technology and its importance, threshing – definition, methods and principles of threshing, types of threshers, components and operation of pedal operated thresher	3, 4
2	Functions and components of mechanical threshers, different types of cylinders used in threshers, and types of mechanical operated threshers	3, 4
	Unit 2	
3	Precaution and care in operation of a thresher- maintenance, troubleshooting methods, terminology of thresher testing; Castor sheller and sun flower thresher- components, working with diagrams	3, 4
4	Winnowing – definition; principles of winnowing; types of winnowers– winnowing fans and winnowers	3, 4
	Unit 3	
5	Drying- definition; advantages; Psychrometric chart- thermodynamic properties of moist air; common uses of psychrometric chart in drying problem analysis	1, 2
6	Moisture content measurement- methods of drying; classification; thin layer drying; deep bed drying; numerical on moisture content	1, 2
	Unit 4	
7	Equilibrium moisture content – definition; importance; methods of determination; EMC models	1, 2
8	Sun drying; Mechanical drying – conduction drying, convective drying, radiation drying, vacuum drying and osmotic drying	1, 2
	Unit 5	
9	Types of dryers – deep bed dryer; Continuous flow dryers, non-mixing (column and recirulatory dryers), mixing (baffle and LSU driers) and fluidized bed dryers	1, 2

10	Rotary dryer, tray dryer, tunnel dryer, vacuum dryer and freeze dryer	1, 2
	Unit 6	
11	Grain storage structures – traditional structures- Morai; Bukhari; and Kothari; Improved storage structures– Pusa bin; RCC bin; Silos; CAP storage structure	1, 2
12	Design of storage godowns	1, 2
	Unit 7	
13	Importance of material handling devices – belt conveyor	2
14	Idler spacing; belt tension; capacity and power requirement	2
	Unit 8	
15	Screw conveyors – drive mechanism- capacity and calculation of power requirement	2
16	Bucket elevator – buckets- drive mechanism- capacity and power requirement- pneumatic conveyor – limitations of conveying	2

Practical's

1	Introduction to agricultural process engineering laboratory
2	Study of different types of screens
3	Measurement of different screens size; length & shape
4	Study of cyclone separator
5	Tutorial on use of psychrometric chart
6	Tutorial on use of psychrometric chart
7	Measurement of moisture content by direct method
8	Measurement of moisture content by indirect method
9	Performance evaluation of sack dryers
10	Performance evaluation of rotary dryers
11	Performance evaluation of continuous flow non-mixing column driers
12	Performance evaluation of continuous flow baffle dryer
13	Performance evaluation of continuous flow mixing type driers (LSU)
14	Performance evaluation of continuous flow mixing type driers (LSU)
15	Visit to local processing industry
16	Evaluation of size reduction/grinding equipment
17	Evaluation of size reduction/grinding equipment
18	Evaluation of size reduction/grinding equipment – numerical problems
19	Evaluation of size reduction/grinding equipment – numerical problems
20	Performance evaluation of attrition mill
21	Performance evaluation of attrition mill
22	Study of different mixing equipments (pasty material)
23	Study of different mixing equipments (pasty material)
24	Study of filtration equipments
25	Study of filtration equipments
26	Performance evaluation of belt conveyor

27	Performance evaluation of screw conveyor
28	Performance evaluation of pneumatic conveyor
29	Performance evaluation of bucket elevator
30	Performance evaluation of grinding equipments
31	Performance evaluation of grinding equipments
32	Brief review of practical's carried out

References

1. Post Harvest Technology of Cereals; Pulses and Oil Seeds, Chakravarthy A. and De D. S., 1988. Oxford and IBH Publishing Co Ltd, Calcutta.
2. Unit Operations of Agricultural Produce, Sahay K. M. and Singh K .K., 1994. Vikas Publishing House Pvt Ltd, New Delhi.
3. Elements of Agricultural Engineering, Jagdishwar Sahay, Standard Publishers and Distributors, Naisarak, Delhi.
4. Principles of Agricultural Engineering Vol. I, Ojha T. P. and Michael A. M., Jain Brothers, New Delhi.

DAE 223 Agricultural Process Engineering - II 2 (1+1)

Objective This course provides knowledge on cleaning, grading, sorting, size reduction, parboiling, milling of cereals and pulses, oilseed processing to minimize post harvest losses to enable the students to acquire skills and to understand the various processing operations.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Cleaning and grading – definition; screening; types of screens; particle motion; screen openings; ideal and actual screen; effectiveness of screen	2, 3
2	Size reduction – principles; laws; procedures and fineness modulus; Crushers – jaw crusher; gyratory crusher; crushing rolls; grinders; attrition mills; hammer mills; ball mills; cutting machines	3
	Unit 2	
3	Rice milling – definition; terminology related to rice; rice processing; modern rice milling process flowchart; layout of modern rice mill	1, 3, 4
4	Rice milling equipment- types of cleaners, destoners and shellers	1, 3, 4
	Unit 3	
5	Rice milling – types of whiteners; Abrasive and fractional	1, 3, 4
6	Types of graders- paddy separator (Stake type) and colour sorters	1, 3, 4
	Unit 4	
7	Parboiling of paddy – introduction, advantages, disadvantages, process variables, physico-chemical changes during parboiling, traditional parboiling methods	1, 3, 4
8	Modern paddy parboiling methods- CFTRI, Jadavpur and pressure parboiling	1, 3, 4

	Unit 5	
9	Wheat milling – introduction; Unit operations- cleaning, conditioning/ tempering; grinding/milling and blending- components of wheat mill	4
10	Maize shelling- introduction, shelling, types of shellers(spring type and cylinder type), dehusker cum sheller	4
	Unit 6	
11	Milling of pulses – introduction, important unit operations in pulse milling, cleaning, conditioning, dehusking and splitting	3, 4
12	Flow charts of wet milling and dry milling of red gram, traditional milling of bengal gram – mini-dal mill – problems of pulse milling in industry – factors affecting pulse milling outturn	3, 4
	Unit 7	
13	Oilseed processing – importance, various post-harvest operations of oil seeds, handling, drying, grading and storage	3, 4
14	Pre-treatments cleaning, dehusking, size reduction and flaking; Heat treatment	3, 4
	Unit 8	
15	Processing of oilseeds – mechanical expression devices – hydraulic press and screw press	3, 4
16	Groundnut oil seed processing – stripping, grading, drying– decortications principle, separation of kernels from shells	3, 4

Practical's

1	Determination of shelling efficiency of groundnut thresher
2	Performance evaluation of power thresher;
3	Determination of shelling efficiency of sunflower thresher
4	Determination of shelling efficiency of castor sheller
5	Determination of winnowing efficiency of winnower
6	Performance evaluation of rubber roll sheller
7	Visit to modern rice mill
8	Determination of oil content of rice bran
9	Visit to rice bran oil extraction plant
10	Determination of bulk density and porosity of grains
11	Measurement of physical properties of wheat
12	Measurement of physical properties of redgram
13	Determination of drying rate of grains
14	Performance evaluation of maize sheller
15	Performance evaluation of groundnut decorticator
16	Brief review of practical's carried out

References

1 Rice Post Harvest Technology, Araullo and Graham M., 1976. IDRC, Canada.

2 Processing Equipment for Agricultural Products, Hall C. W. and Davis D. C., 1979. AVI Publishing Co Inc, Westport, Connecticut.

3 Unit Operations of Agricultural Produce, Sahay K. M. and Singh K. K., 1994.Vikas Publishing House Pvt Ltd, New Delhi.

4 Post Harvest Technology of Cereals; Pulses and Oil Seeds, Chakravarthy A. and De D. S., 1988. Oxford and IBH Publishing Co Ltd, Calcutta.

DAE 231 Soil and Water Conservation Engineering and Practices 2 (1+1)

Objective To acquaint and equip the students with the subject of soil erosion, water erosion, erosion control and water conservation measures.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Hydrologic cycle and its components: Precipitation- characteristics of rainfall in India, types of monsoon, formation types and forms of precipitation, measurement of rainfall, recording type rain gauge (natural, siphon type, weighing bucket type and tipping type) and non recording type rain gauge (Symon guage) and rainfall intensity, definition	2
2	Average depth of rainfall over an area – Arithmetic mean, Thiessen polygon and Iso-hyetal methods – intensity, duration and return period relation	2
	Unit 2	
3	Soil erosion – geological erosion, accelerated erosion – agents of erosion – climate, topography, soils, vegetation, erosion by water, erosion by wind and erosion by gravity	1
4	Soil erosion by water – various types of erosion by water – raindrop splash, sheet, rill, gully and stream channel erosion; Wind erosion – process description ,initiation of movement, transportation and deposition	1
	Unit 3	
5	Rainfall- runoff relation – volume and peak rate of runoff – rational method, hydrologic soil cover complex method	2
6	Computation of velocity of water in open channels – Manning's formula, cross section and hydraulic radius of various channel shapes – trapezoidal, triangular and parabolic - permissible velocities	2
	Unit 4	
7	Estimation of soil loss: Universal soil loss equation – Its components-explanation of each component and its equation	1
8	Erosion control measures – agronomic measures, contour cultivation, strip cropping, importance of contour farming, mulching	1
	Unit 5	
9	Contour bunds - construction and maintenance explanation of features like spacing, height and cross section of contour bunds	3
10	Graded bunds construction and maintenance, list of outlets for bunds	3
	Unit 6	
11	Grassed waterways- wetted perimeter and hydraulic radius of trapezoidal, triangular and parabolic section and diversion drains	2

12	Bench terraces – types, construction and maintenance; Explanation of features like Spacing ,height, width and cross section of bench terraces	2
	Unit 7	
13	Contour trenches- types, contour stone walls, applicability of benches and contour stone walls	3
14	Grade stabilization structures –types, drop spillways, drop-inlet spillways and chute spillways, their applicability and limitations	3, 5
	Unit 8	
15	Water harvesting – dugout and embankment type ponds– steps involved for the design of embankment ponds and farm ponds	1
16	Land use capability classification and explanation of eight classes	5

Practical's

1	Study of hydrologic cycle
2	Problems on average depth of rainfall
3	Problems on return period, intensity and duration
4	Problems on rational formula
5	Problems on hydrologic soil cover complex method
6	Problems on contour bunds
7	Case study on graded bunds
8	Case study on bench terraces
9	Case study on contour trenches and stone walls
10	Visit to a research farm
11	Dugout ponds – computation of storage
12	Embankment ponds – computation of earthwork, brief coverage on stability of embankment
13	Land capability classification
14	Design procedures for drop spillways
15	Visit to soil conservation works
16	Brief review of practical's carried out

References

1	Hydrology and Soil Conservation Engineering, Ghanshyam Das, PHI Learning Pvt. Ltd., New Delhi.
2	Land and Water Management Engineering, Murthy V. V. N. and Madan K. Jha., Kalyani Publishers, New Delhi.
3	Manual on Soil and Water Conservation, USDA, Oxford Book Company.
4	Watershed Management – Guidelines for Indian Condition, E. M. Tideman, Omega Scientific Publishers, New Delhi.
5	Soil and Water Conservation Engineering, Suresh R., Standard Publishers and Distributors, New Delhi.

DAE 232 **On-Farm Irrigation and Drainage Practices** **3 (1+2)**

Objective To impart the knowledge and skills on water requirements of crops, duty, delta, measurement of irrigation water, evapotranspiration, irrigation efficiencies, surface irrigation methods, problems of water logging, surface and sub surface drainage systems for reclamation and to enable the students to understand the practical aspects of irrigation and drainage systems to improve land productivity and enhance the crop production.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Irrigation: Introduction and necessity, irrigation development and irrigation terminology, classification of irrigation works in India	1, 5
2	Objectives of irrigation development and management, surface water sources of India, ground water sources of India and ground water regions of India	1, 5
	Unit 2	
3	Duty, delta and base period: Definitions, duty and delta relationship and problems	5
4	Measurement of irrigation water: Units of measurement, methods of measurement (list only), direct measurement of velocity by using the current meter	5, 6
	Unit 3	
5	Evaporation, transpiration and concept of evapotranspiration and estimation of evapotranspiration- Blaney Cridlle, Throrth Waite, Penman and Modified Penman- Monteith equations	1, 5
6	Water and irrigation water requirement of crops- importance of water in plant growth, procedures for working out the net irrigation (depth of irrigation) and gross irrigation requirement	1, 5
	Unit 4	
7	Irrigation efficiencies – conveyance, application, storage, distribution and water use efficiency and related problems	1, 2, 5
8	Surface methods of water applications- classification; Border irrigation method- basic details, components of border irrigation- width, length and slope for different soils and their adaptability, hydraulics and design for length of border irrigation (Israelson's equation only)	1, 2, 5
	Unit 5	
9	Check basin irrigation method- types, advantages and disadvantages, adaptability and design considerations	1, 2, 5
10	Furrow irrigation method- types, adaptability, characteristics, hydraulics and design considerations	1, 2, 5
	Unit 6	
11	Water logging: Introduction, forms of excess water, effects, causes and impacts of water logging; Approach to drainage problems, interrelationship of irrigation and drainage	2, 3
12	Surface drainage system: Definition, types and applications of surface drainage methods; Design of open ditches (use of Manning's Equation)	2, 3

Unit 7

13	Drainage coefficient and its importance in drainage design, various methods to determine drainage coefficient – Cypress Creek formula (only) and problems	2, 3
14	Hydraulic Conductivity: Single auger hole method and assumptions of Hooghoudt's analysis (Hooghoudt's equation only): Inverse auger hole method (equation only) and problems	2, 3

Unit 8

15	Sub surface drainage system – Purpose and benefits of sub-surface drainage, investigations for subsurface drainage (list only), layouts of tile drainage systems, capacity of tile drains, grades, sizes and materials of tile drains including envelope materials	3
16	Tile Drainage: Depth and spacing of tile drains, Hooghoudt's equation for spacing of tile drains under steady state flow condition (only) and problems	2, 3

Practical's

1	Problems on duty- delta relations
2	Study of measurement of velocity by using the current meter
3	Study of determination of evapotranspiration by Blaney-criddle formula
4	Study of determination of evapotranspiration by Thornthwaite formula
5	Study of determination of evapotranspiration by Penman formula
6	Study of determination of evapotranspiration by Modified Penman- Monteith formula
7	Study of determination of evapotranspiration by pan evaporation formula
8	Study of irrigation water requirements for different crops
9	Computation of different irrigation efficiencies
10	Study of border irrigation system
11	Study of check basin irrigation system
12	Study of furrow irrigation system
13	Study of surface drainage system for flat areas
14	Study of surface drainage system for slopping areas
15	Determination of hydraulic conductivity by using single auger hole method
16	Determination of hydraulic conductivity by using Inverse auger hole method
17	Determination of drainage coefficient by using Cypress Creek formula
18	Design of open ditches using Manning's formula
19	Study of layouts of subsurface drainage
20	Spacing design for tile drains using Hooghoudt's equation under Steady state condition
21	Cost estimation of surface drainage system
22	Cost estimation of sub-surface drainage system
23	Design problem of tile drainage system under steady state condition
24	Problem on capacity of tile drains using Manning's formula
25	Study of different envelope materials
26	Study of drainage execution machinery

27	Visit to surface irrigation systems
28	Visit to subsurface irrigation systems
29	Visit to irrigation project management
30	Visit to surface drainage system
31	Visit to subsurface drainage system
32	Brief review of practical's carried out

References

1. Irrigation - Theory and Practice, Michael A. M., 2015. Vikas publishing Private limited, New Delhi.
2. Principles of Agricultural Engineering, Michael A. M. and. Ojha T. P., 2013. Jain Brothers Publishers, New Delhi.
3. Land and Water Management Engineering, Murthy V. V. N. and Madan K. Jha, 2013. Kalyani Publishers, Ludhiana.
4. Irrigation and Drainage, Lenka D., 2005. Kalyani Publishers, Ludhiana.
5. Irrigation Engineering and Hydraulic Structures, Garg, S. K., 2012. Khanna Publishers, New Delhi.
6. Engineering Hydrology, Subramanya K., 2013. Tata McGraw Hill Publishing Co Ltd, New Delhi.

DAE 233 Micro Irrigation Principles and Practices 3 (1+2)

Objective To impart knowledge and skills to the student in the design of sprinkler and micro irrigation systems to improve productivity of different crops under the scenario of limited availability of water resources and economic evaluation of various micro irrigation systems.

Theory Lecture No.	Contents	References
	Unit 1	
1	Introduction to micro irrigation systems- scope and application adaptability and limitations - different types of micro irrigation systems	3, 4, 5
2	Sprinkler irrigation- suitable crops, soils, advantages and disadvantages- basic components of sprinkler irrigation system-types of sprinkler irrigation systems	1, 3
	Unit 2	
3	Hydraulic design of a sprinkler irrigation system- recommended pressure and discharge for nozzle size, water spread area, index of jet break up, application rate	1, 3
4	Evaluation of sprinkler irrigation uniformity and efficiency- moisture distribution patterns, importance of uniformity, testing of uniformity, distribution uniformity, uniformity coefficient, sprinkler spacing- effect of wind speed on working of the system, precipitation profiles	1, 3

	Unit 3	
5	Design and layout of sprinkler irrigation system- inventory of resources, selection of sprinkler nozzle, selection and design of lateral, sub mains, mainline, selection of required pump, field evaluation and cost estimation of a given layout	1, 3
6	Operation and maintenance of sprinkler irrigation system- filter cleaning, main and sub main flushing, maintenance of pipes and other fittings, sprinkler head , trouble shooting and remedies	1, 3
	Unit 4	
7	Drip Irrigation, historical development, application to different crops and area under drip irrigation in various states and countries- advantages and disadvantages	2, 3
8	Different components of drip irrigation system and design considerations	2, 3
	Unit 5	
9	General considerations: Wetting pattern; Irrigation water requirement; Capacity of drip irrigation system	2, 3
10	Emitter selection: Introduction- manufacturing characteristics- hydraulic characteristics- operational characteristics- emitter spacing, capacity and emission uniformity- pressure head- discharge relationship of emitter	2, 3
	Unit 6	
11	Hydraulics of drip irrigation system: Pressure variation in irrigation pipe line-; Design of lateral, sub main and main pipes	2, 3
12	Pump selection- types of pumps- size of pumping unit- power requirement and pump selection- head discharge curve	2, 3
	Unit 7	
13	Installation and maintenance guidelines: Micro-irrigation system installation; Operation of drip irrigation system; Maintenance of micro-irrigation System- field evaluation and cost analysis of drip irrigation system	2, 3
14	Fertigation system- need of fertigation- advantages and limitations of fertigation; Types of fertilizers- fertilizers solubility and their compatibility- safety precautions, back flow prevention	2, 3
	Unit 8	
15	Fertigation system design: Fertigation parameters- estimation of fertilizer requirement- frequency of fertigation, duration and capacity of fertilizer tank	2, 3
16	Fertilizers application methods: Solid fertilizers application methods; Liquid fertilizers application methods- methods of fertigation	2, 3

Practical's

1	Study of different components of sprinkler irrigation system
2	Determination of water requirement and irrigation scheduling
3	Study on layout of sprinkler irrigation system
4	Design of sprinkler irrigation for different crops
5	Selection of different components of sprinkler irrigation system

6	Study of operation and maintenance of sprinkler irrigation system
7	Field visit to college farm and nearby framers fields
8	Troubles and remedies in sprinkler irrigation system
9	Field evaluation on distribution pattern
10	Field evaluation of uniformity coefficient
11	Cost estimation of sprinkler irrigation system for field crops
12	Economic evaluation of sprinkler irrigation system
13	Study of different components of drip irrigation system
14	Determination of irrigation scheduling for row crops under drip irrigation system
15	Determination of irrigation scheduling for orchards under drip irrigation system
16	Study of layout of drip irrigation system
17	Design of drip irrigation for different vegetable crops
18	Design of drip irrigation for sugarcane
19	Design of drip irrigation for mango
20	Demonstration of fertigation using fertilizer tank
21	Demonstration of fertigation using venture
22	General maintenance of drip irrigation system
23	Demonstration of chlorine treatment in maintenance of drip irrigation system
24	Demonstration of acid treatment in maintenance of drip irrigation System
25	Computation of pressure variation in pipes
26	Field visit to nearby micro irrigation fields
27	Cost estimation of drip irrigation system for field crops
28	Economic evaluation of drip irrigation system
29	Study of sub surface drip irrigation
30	Study of micro sprinklers
31	Special application of drip and sprinkler irrigation systems
32	Brief review of practical's carried out

References

1. Principles of sprinkler irrigation, Mane M. S. and Ayare B. L., 2007. Jain Brother, New Delhi.
2. Principles of Drip Irrigation Systems, Mane M. S., Ayare B. L. and Magar S., 2006. Jain Brothers, New Delhi.
3. Irrigation: Theory and Practice, Michael A. M., 2012.Vikas Publishing House, New Delhi.
4. Micro irrigation for Cash Crops, Choudary M. L. and Kadam U. S., 2006. West Ville Publishing House, New Delhi.
5. Land and Water Management Principles, Suresh R., 2008. Standard Publishers Distributors, New Delhi.

DAE 241 Engineering Mechanics & Materials Testing 2 (1+1)

Objective To impart knowledge and training to students on the basic principles of engineering mechanics of solid systems involving forces, moments, stresses and shear forces for applications and testing of materials needed in engineering structures.

Theory Lecture No.	Contents	References
	Unit 1	
1	Introduction of engineering mechanics and application of mechanics in engineering; Divisions of engineering mechanics, system of units and basic concept of force system	1
2	Effects and characteristics of a force, composition and resolution of forces analytical and graphical methods, parallelogram law of forces	1
	Unit 2	
3	Moment of a force, types of moments, application of moments, levers and types of levers	1
4	Parallel forces- classification of parallel forces, couple, classification and characteristics of a couple	1
	Unit 3	
5	Principles of equilibrium, methods for the equilibrium of coplanar forces, analytical method for the equilibrium of coplanar forces	1
6	Lami's theorem, converse of the law of triangle of forces, law of polygon of forces, conditions of equilibrium, types of equilibrium	1
	Unit 4	
7	Centre of gravity, centroid, methods for centre of gravity, axis of reference and centre of gravity of plane figures	1
8	Calculation of CG of symmetrical and unsymmetrical sections; Moment of inertia, methods for moment of inertia; Theorem of parallel axis, moment of inertia of plane figures and composite sections	1
	Unit 5	
9	Basic link mechanism, rigid body, resistant body, kinematic link, classification of links	2
10	Kinematic pair, kinematic pair types, difference between machine and mechanism	2
	Unit 6	
11	Simple machines, uses of simple machines, definition, input and output of a machine, velocity ratio, mechanical advantage, efficiency of a machine and related problems	2
12	Simple pulleys – first system of pulley, second system of pulley, third system of pulley; Common lifting machines – simple wheel and axle, differential wheel and axle	2
	Unit 7	
13	Classification of engineering materials, importance of materials, selection of material	3
14	Testing of engineering materials, types of tests and its classification	3
	Unit 8	
15	Introduction of iron and steel, raw material of iron, manufacture of steel	3
16	Properties of steel, mechanical treatment of steel, heat treatment and market forms of steel	3

Practical's

1	Problems/tutorials on composition and resolution of forces- movement of a force-couples
2	Problems related to resolution of forces, resultant of concurrent forces
3	Problems related to resultant of a concurrent coplanar forces
4	Problems related to Lami's theorem, equilibrium of forces
5	Problems related to lifting machines
6	Analysis of wheel and axle
7	Analysis of screw jack, rack and pinion
8	Problem related to frictional effort, load and efficiency of a machine
9	Problems related to centroids of composite areas
10	Problems related to moment of inertia, radius of gyration
11	Study of steering gear mechanism
12	Study of crank and slotted lever mechanism
13	Mechanical properties of engineering material
14	Distructive tests of a material
15	Non destructive tests of a material
16	Brief review of practical's carried out

References

1	A Textbook of Engineering Mechanics, Khurmi R. S. , S Chand and Company Ltd, New Delhi.
2	Engineering Mechanics, Siva Shankar P., Falcon Publishers, Koti, Hyderabad.
3	Engineering materials, Rangwala, Charotar Publishing House Pvt, Ltd, Gujarat.
4	Engineering Materials, Pakirappa and Kumar V. N., Radiant Publishing House, Koti, Hyderabad.
5	Engineering Mechanics, Pakirappa and Kumar V. N., Radiant Publishing House, Koti, Hyderabad.
6	Engineering Mechanics, Lakshmi Prasad S. R., Falcon Publishers, Koti, Hyderabad.

DAE 242 Surveying and Levelling – II 3 (1+2)

Objective To enable the students to develop skills for taking up land grading and levelling of any agricultural field by plane, profile, contour adjustment, estimating the cuts and fills earthwork. Further to enable the students thorough with theodolite traversing, calculation of volumes, tachometric surveying. To impart knowledge on electronic survey instruments for speedy and accurate survey.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Contour: Methods of contour; Direct method for locating contour, location of contours by direct method using radial lines; Indirect method for locating contours – grid method or squares method, cross section method and interpolation of contours by estimation, arithmetical calculation and graphical methods	1, 3, 4

2	Tracing contour gradient, marking alignments of road, railway/canal route on a contour map, capacity of reservoir using contour maps, measurement of drainage basin area, Numerical Problems	1, 3, 4
	Unit 2	
3	Land levelling designs: Plane, profile, plan inspection and contour adjustment methods	5
4	Theodolite survey: Introduction, classification, component parts of theodolite, Basic definitions, fundamental lines of theodolite	2, 4
	Unit 3	
5	Conditions of adjustment, reading of vernier scales, temporary adjustment of a theodolite– setting up of the theodolite, centering, levelling up, focusing of the eye piece and focusing the objective	2, 4
6	Traversing with theodolite: direct observation of angles and fast needle method, selection of traverse stations, types of errors in theodolite surveying – instrumental errors, personal errors and natural errors	2, 4
	Unit 4	
7	Trigonometric levelling: Reading of vertical angles, measurement of vertical angles between two points A & B, index error and importance of reading with both faces	2
8	Derivations for finding elevation and distances of the object when the object base is accessible and when the object base is inaccessible	2
	Unit 5	
9	Tacheometric surveying: Introduction, purpose, instruments used in tacheometric survey, systems of tacheometric measurements – stadia hair method, movable hair method, tangential tacheometry and principle of tacheometry	2
10	Derivation of distance and elevation formula for horizontal line of sight in tacheometric survey, different tacheometric constants	2
	Unit 6	
11	Curves: Introduction, classification of curves – simple curve, compound curve, reverse curve and transition curve, degree and radius of the curves – relation between degree and radius of the curves based on fixed length chord	2
12	Elements of curves, Setting out circular curves by chain and tape– by taking offsets from long chord, by taking radial offsets from the tangents, by taking perpendicular offsets from the tangents and Offsets from chords produced	2
	Unit 7	
13	Electronic survey instruments: Electro magnetic distance measurements (EDM) - basic functions of EDM instruments, classification of EDM instruments, principle used in EDM instruments, reduction of EDM lines; Distomat – Distomat D_1-1000, Distomat D_1-5S, Distomat D_1-3000, Distomat D_1-3002, Distomat DIOR-3002 and Wild Tachymat TL 2000	2
14	Electronic theodolite, Global Position System (GPS), segments of GPS – space segment, control segment and user segment	2

Unit 8

15	Digital planimeter – applications, special features and method of measurement	3
16	Total station – Components, Advantages and disadvantages of Total station	2

Practical's

1	Grid survey for developing a contour map
2	Drawing of contour map (Grid method)
3	Calculation of earth work volumes and reservoir capacity from contour plans
4	Land levelling design by plane method
5	Land levelling design by profile method
6	Land levelling design by plan inspection and contour adjustment methods
7	Study of transit theodolite
8	Temporary adjustments of theodolite
9	Measurement of horizontal angle by general method
10	Measurement of horizontal angle by repetition method
11	Measurement of horizontal angle by reiteration method
12	Laying out angles in the field
13	Traversing by the method of inclined angle
14	Traversing by the method of deflection angles
15	Theodolite traverse computations
16	Plotting of traverse by independent co-ordinates method
17	Calculation of areas of traverse method
18	Reading vertical angles with transit theodolite
19	Measurement of the height of an electrical pole
20	Finding elevation and distance of an object
21	Numerical problems on theodolite traverse
22	Determination of tacheometric constants
23	Problems on tacheometric survey
24	Setting out a curve with chain/tape
25	Study of digital theodolite
26	Measurement of horizontal and vertical angles with digital theodolite
27	Study and practice with Global Position System in field
28	Study of digital planimeter
29	Measurement of a plan area using digital planimeter
30	Study of total station
31	Measurements with Total station (distance, area and volume)
32	Brief review of practical's carried out

References

1 A Text Book of Surveying-I , Krishna Sarma H., Radiant publishing houses, Hyderabad.

2 A Text Book of Surveying- II, Krishna Sarma H., Radiant publishing houses, Hyderabad.

3 A Text Book of Surveying-I, Nagesh kumar G., Falcon publishers, Koti, Hyderabad.

4 Surveying and Levelling Vol. I, Kanetkar T. P. and Kulkarni S. V., Pune Vidyarthi Griha Prakashan, Pune.

5 Irrigation Theory and Practice, Michael A. M.,1992. Vikash Publishing House Pvt Ltd, New Delhi.

DAE 243 Principles of Thermodynamics and Heat Engines 2 (1+1)

Objective To impart knowledge and skills to the student on the basics and principles of thermodynamics, laws of thermodynamics and thermodynamic cycles. Further the student is trained on principles and working of internal combustion (IC) engines, IC engine components and different IC engine systems.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Thermodynamics: Definition, thermodynamics system and its classification; Thermodynamic properties of a system; Thermodynamic cycle – Pressure and temperature and its scales for measuring – NTP and STP – energy- types of stored energy; Law of conservation of energy	1, 4, 5
2	Heat – specific heat – heat capacity – water equivalent – mechanical equivalent of heat; Work – power; Laws of thermodynamics – Zeroth law of thermodynamics; First law of thermodynamics; Second law of thermodynamics; Coefficient of performance	1, 4, 5
	Unit 2	
3	Properties of perfect gases – introduction; Laws of perfect gases – Boyle's law – Charles law – Gay-Lussac law; General gas equation – Joule's law – characteristic equation of a gas – Avogadro's law	1, 4, 5
4	Universal gas constant – specific heat of a gas and its types – enthalpy of a gas – molar specific heats of a gas; Regnault's law; Relationship between specific heats – ratio of specific heats	1, 4, 5
	Unit 3	
5	Thermodynamic processes of perfect gases – introduction – classification of thermodynamic processes – work done during a non-flow process – application of first law of thermodynamics to a non-flow process – heating and expansion of gases in non-flow processes - constant volume process – constant pressure process	1, 4, 5
6	Adiabatic process; Otto cycle; Diesel cycle	1, 4, 5
	Unit 4	
7	Internal combustion engine and its types – principle and working of IC engine; Four stroke cycle engine; Two stroke cycle engine – comparison between 4 stroke and 2 stroke engines	2, 3
8	Principle and operation of diesel and petrol engines – engine components – valve working and valve timing diagram	2, 3

Unit 5

9	Measurement of engine power: Terminology connected with engine power – fuels – classification of fuels – calorific value of fuels – properties of fuel – quality of fuel – different fuel tests	1, 2, 3
10	Fuel combustion in petrol and diesel engines – fuel supply system in spark ignition engine and diesel engine – fuel injection pump – fuel filter – air cleaner	1, 2, 3

Unit 6

11	Governor – principle of governor – classification of governing system – centrifugal governor – governor regulation – governor hunting	2, 3
12	Lubrication system in IC engines – splash system – forced feed system – oil pump – oil filters – crankcase breather – relief valve – grease-troubles, care and maintance of lubrication system	2, 3

Unit 7

13	Ignition system in IC engine – types of ignition system – battery ignition – components of battery ignition system	2, 3
14	Storage battery – care and maintenance of battery – magneto ignition system and its components – ignition by heat of compression	2, 3

Unit 8

15	Cooling system – purpose of cooling system – air cooling – water cooling – open jacket method – thermo siphon method	2, 3
16	Forced circulation method – components in forced circulation method – pressurized cooling – troubles, care and maintenance of cooling system	2, 3

Practical's

1	Study of different components of IC engine
2	Dismantling of IC engine components
3	Dismantling of IC engine components
4	Assembling of IC engine components
5	Assembling of IC engine components
6	Study the working of four stroke petrol engine
7	Study the working of four stroke diesel engine
8	Study the working of two stroke petrol engine and diesel engine
9	Terminology related to engine power and its problems
10	Terminology related to engine power and its problems
11	Study the working principle of forced feed fuel supply and ignition system
12	Study the working principle of forced feed cooling and lubrication system
13	Study the different type of dynamometers; Rope brake Test; Prony break test
14	Repairs and maintenance of IC engines
15	Repairs and maintenance of IC engines
16	Brief review of practical's carried out

References

1 A Text Book of Thermal Engineering, Khurmi R. S. and Gupta J. K., 2013. S Chand and Company Pvt Ltd, Ram Nagar, New Delhi.

2 Elements of Agricultural Engineering, Jagdishwar Sahay, 2015. Standard Publishers Distributors, Naisarak, Delhi.

3 Principles of Agricultural Engineering Vol. I, Ojha T. P. and Michael A. M., 2018. Jain Brothers, Karol Bagh, New Delhi.

4 Thermal Engineering Vol. I, Pakirappa and Naresh V., Radiant Publishing House, Koti, Hyderabad.

5 Thermal Engineering Vol. I, Rao S. S. L., Falcon Book House, Koti, Hyderabad.

DAE 244 Strength of Materials 2 (1+1)

Objective The students acquire the knowledge about the advanced aspects of engineering materials 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.

Theory

Lecture No.	Contents	References
	Unit 1	
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) and relation between them- factor of safety	1, 3
2	Stresses in uniformly tapered circular sections- stresses in bars of composite sections. Thermal stresses and strains in simple bars and composite bars- elongation ratio- modular ratio	1, 3
	Unit 2	
3	Slope and deflection of a beam or column- its practical importance- diagrammatic representation-methods of finding out slopes and deflections of beams, double integration method	1, 3
4	Slope and deflection equations of a simply supported beam with a central point load, simply supported beam with eccentric point load- diagrammatic representation	1, 3
	Unit 3	
5	Simply supported beam with a uniformly distributed load-diagrammatic representation- notations to be used to represent like load, load per running meter	1, 3
6	Columns and struts- diagrammatic representation of a column and strut- classification- Euler's column theory and assumptions of Euler's column theory	1, 3
	Unit 4	
7	Buckling load- derivations for buckling load of a column with one end fixed other free-with one end fixed and other hinged	1, 3
8	Expression for buckling load of a column with both ends hinged- with both ends fixed	1, 3

	Unit 5	
9	Types of end conditions of columns; both ends hinged, both ends fixed, one end fixed and other is hinged & one end fixed and another end is free; Limitations of Euler's formula; Rankine's formula for columns	1, 3
10	Types of joints – uses of rivets- lap and butt- riveted joints -overlap-strength of a rivet and riveted joint-efficiency of a riveted joint	1, 3
	Unit 6	
11	Design of riveted joints-spacing of rivets-pitch of the rivet- eccentric riveted connections	1, 3
12	Welded joints, types of welded joints- fillet of weld-lap joint -butt joint-strength of welded joints, efficiency of weld- technical terms	1, 3
	Unit 7	
13	Design of welded joints, eccentric welded joints- thickens and size of weld	1, 3
14	Propped cantilever and beams – fixed and continuous beams- deflection and slope equations	1, 3
	Unit 8	
15	Super position theory: Clapeyron's theorem of three moments and application of Clapeyron's theorem of three moments	1, 3
16	Moment distribution methods- shear force and bending moment diagrams and their uses- analysis of statistically indeterminate beams	1, 3

Practical's

1	To perform the tension test on metal specimen MS to observe stress – strain behavior, modulus of elasticity (E), ultimate stress, permissible stress, per cent elongation and to study its fracture
2	To perform the tension test on metal specimen CI to observe stress – strain behavior, modulus of elasticity (E), ultimate stress, permissible stress, per cent elongation and to study its fracture
3	To perform compression test on concrete cylinders and cubes
4	To perform compression test on CI, MS and wood material
5	To perform the bending test on the specimens of MS and wooden beams
6	To perform the bending test on the specimens of Plain concrete and RCC beams
7	To determine Young's modules 'E' of beams with the help of deflection produced at centre due to loads placed at center
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 (GI pipes, MS and 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 and Charpay's impact tests on the given specimens
13	To determine the fatigue strength of a given specimen

14	To determine compressive and 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	Brief review of practical's carried out

References

1 Strength of Materials, Khurmi R. S., 2001. S Chand & Co, Ltd, New Delhi.
2 Mechanics of Structures Vol.I, Junarkar S. B., 2001. Choratar Publishing House, Anand.
3 Strengths of Materials, Ramamrutham S., 2003. Dhanpat Rai and Sons, New Delhi.

DAE 245 Principles of Electrical Engineering & Farm Electricity 2 (1+1)

Objective To impart knowledge to students on the types of electrical machines, motors, generators and power utilization techniques for efficient energy utilization in the farms.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Introduction about course; conductor, insulator and semiconductor	1, 2, 3 and 4
2	Terminology related to electrical engineering-resistance, current, conductance, capacitance and specific resistance	1, 2, 3 and 4
	Unit 2	
3	Ohm's law and limitations of ohm's law	1, 2, 3 and 4
4	Resistance in series and parallel; series and parallel combination	1, 2, 3 and 4
	Unit 3	
5	Division of current in parallel circuits	1, 2, 3 and 4
6	Electric power and energy-definitions of fundamental units	1, 2, 3 and 4
	Unit 4	
7	Conducting materials – low resistivity and high resistivity and its properties –properties and applications of copper and aluminum	1, 2, 3 and 4
8	Heating effects of electric current – filament or incandescent lamp	1, 2, 3 and 4
	Unit 5	
9	Fluorescent lamp – electric kettle – electric Iron – space heater	1, 2, 3 and 4
10	Capacitance –capacitance equation – types of capacitors	1, 2, 3 and 4
	Unit 6	
11	Uses of capacitors-capacitors in series and parallel	1, 2, 3 and 4
12	Insulating materials – properties – classifications	1, 2, 3 and 4
	Unit 7	
13	Farm electricity – use of electricity – generation of electricity	4
14	Generator, motor and alternator	4
	Unit 8	
15	Selection, installation and maintenance of electric motors	4
16	Transformer – transmission and distribution of electric power	4

Practical's

1	Tutorial on Ohm's law, resistance in series, parallel and combination
2	Tutorial on Ohm's law, resistance in series, parallel and combination
3	Construction of two lights in series by one switch (PVC wiring)
4	Construction of two lights in parallel by two switches (PVC wiring)
5	Tutorial on division of current in parallel circuits
6	Tutorial on electric work, power and energy
7	Tutorial on electric work, power and energy
8	Tutorial on capacitance in series and parallel
9	Tutorial on capacitance in series and parallel
10	Study of the constructional details of DC generator
11	Study of the constructional details of dynamo
12	Study of the installation and maintenance of electric motor
13	Study of the hostel wiring
14	Study of the godown wiring
15	Study of the fluorescent lamp (Tube light) wiring
16	Brief review of practical's carried out

References

1	Basic Electrical Engineering, Raja Lingam M., Radiant Publishing house, Koti, Hyderabad.
2	Basic Electrical Engineering, Ravi Kumar I., Radiant Publishing house, Koti, Hyderabad.
3	Basic Electrical Engineering, Narasimha Rao K. D. V., Falcon Publishers, Hyderabad.
4	Elements of Agricultural Engineering, Jagdishwar Sahay, Standard Publishers and Distributors, Naisarak, Delhi.

DAE 251 Engineering Mathematics - II 2 (1+1)

Objective To import the knowledge of different mathematical methods to form and solve different equations for application in solving the engineering problems in the field of fluid mechani hydrology, drainage, heat and mass transfer and processing operations.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Definition of differential equation, order and degree of differential equation Formation of differential equations	4, 5
2	Solutions of differential equations: Definition of general solution, particular solution	4, 5
	Unit 2	
3	Differential equations of first order and first degree: Solutions, to differential equations of first order and first degree: (i) Variables separable (ii) Homogeneous differential equations	4, 5

Unit 3

4	Linear differential equations : $\frac{dy}{dx}$ + P(x) y= Q(x)	4, 5
5	Exact differential equations: General solution of M dx + N dy = 0	4, 5

Unit 4

6	Equations reducible to exact equations: Integrating factors: (i) By inspection (ii) If M dx + N dy = 0 is homogeneous	4,5
7	Integrating factors: (i) If M dx + N dy = 0 is of the form y f(x,y) dx + xg(x,y) dy =0 (ii) If $\frac{1}{N}\left[\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right]$ = f(x) (or) $\frac{1}{M}\left[\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right]$ = g(y)	4, 5

Unit 5

8	Differential equations of higher order with constant coefficients (Second order), methods of finding complementary functions f(D)y = Q(x)	4, 5
9	Methods of finding particular integrals inverse operator $\frac{1}{D}$, $\frac{1}{D-a}$ PI: case (i) Q(x) = e^{ax+b} (ii) Q(x) = Sin(ax+b) or Cos(ax+b)	4, 5
10	Methods of finding particular integrals inverse operator $\frac{1}{D}$, $\frac{1}{D-a}$ (i) Q(x) = x^n	4, 5

Unit 6

11	Fourier series: Euler's formulae – Dirichlet's conditions – functions having arbitrary period	4, 5
12	Even and odd functions- half range sine and cosine series	4, 5

Unit 7

13	Coordinate geometry- straight lines: Various forms of straight lines, angle between lines, perpendicular distance from a point, distance between parallel lines- examples	1, 2, 3
14	Circle : Locus of a point, circle, definition- circle equation given (i) centre and radius, (ii) two ends of a diameter, (iii) centre and a point on the circumference, (iv) three non collinear points and (v) centre and tangent equation-general equation of circle-finding centre, radius: Tangent, normal to circle at a point on it	1, 2, 3

Unit 8

15	Conic sections – standard forms of parabola – finding vertex, focus, axis, direcctrics and length of latus rectum- equation of tangent and normal; Ellipse – standard forms of ellipse – finding vertex, focus, axis, directrics, eccentricity and length of latus rectum - equation of tangent and normal	1, 2, 3
16	Hyperbola - finding vertex, focus, axis, direcctrics, eccentricity and length of latus rectum - equation of tangent and normal	1, 2, 3

Practical's

1	Problems on formation of differential equations
2	Problems on variable separable and homogenous

3	Problems on Linear differential equations : $\frac{dy}{dx}$ + P(x) y= Q(x)
4	Problems on exact differential equations: General solution of M dx + N dy = 0
5	Problems on equations reducible to exact equations: Integrating factors: (i) By inspection (ii) If M dx + N dy = 0 is homogeneous
6	Problems on Integrating factors: If M dx + N dy = 0 is of the form (i) y f(x,y) dx + xg(x,y) dy = 0 (ii) If $\frac{1}{N}\left[\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right]$ = f(x) (or) $\frac{1}{M}\left[\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right]$ = g(y)
7	Problems on differential equations of higher order with constant coefficients (Second order), methods of finding complementary functions f(D)y = Q(x)
8	Problems on methods of finding particular integrals inverse operator $\frac{1}{D}$, $\frac{1}{D-a}$ PI: case (i) Q(x) = e^{ax+b} (ii) Q(x) = Sin(ax+b) or Cos(ax+b)
9	Problems on methods of finding particular integrals inverse operator $\frac{1}{D}$, $\frac{1}{D-a}$ Q(x) = x^n
10	Problems on fourier series
11	Problems on even and odd functions
12	Problems on half range Sin and Cosine series
13	Problems on straight lines
14	Problems on circles
15	Problems on parabola
16	Problems on ellipse and hyperbola

References

1. Engineering Mathematics-I, Vishnu Murthy M., Falcon's Publications, Koti, Hyderabad.
2. Engineering Mathematics-I, Ramana K. V. and Kusuma K., Falcon Publications, Koti, Hyderabad .
3. Engineering Mathematics- I, . Raju M. V. S. L. D. N. and Ramana K. V., VGS Book Links, Vijayawada.
4. Engineering Mathematics-II, Vishnu Murthy M., Falcon's Publications, Koti, Hyderabad.
5. Engineering Mathematics-II, Ramana K. V. and Kusuma K., Falcon Publications, Koti, Hyderabad.

DAE 311 Tractor Systems, Operation and Maintenance 3 (2+1)

Objective To enable the students for acquiring the knowledge pertaining to tractor functioning systems like transmission system, clutch, types of clutches, types of gear, sliding, constant mesh type tractor power outlets like PTO, belt pulley, drawbar, traction theory, rolling resistance and rim pull.

Theory Lecture No.	Contents	References
	Unit 1	
1	Introduction- history of tractor development- classification of tractors based on structural design and purpose	1

2	Tractor components-Selection of tractor based on land holding, cropping pattern, repairing facility, test reports and resale value	1, 2
3	Introduction to various functional systems of tractor and general precautions for various systems: Cooling System; Lubrication System; Ignition System; Hydraulic system	1
4	Power tiller-components – operation- power transmission- components-repair and maintenance of power tiller	1
	Unit 2	
5	Tractor power transmission system-functions of power transmission system- clutch–types and its functions- friction clutch- dog clutch and fluid coupling clutch- necessity of clutch	1
6	Single plate clutch- components- operation- multi plate clutch- operation-dog clutch	1
7	Fluid coupling clutch- constructional details- features- working of fluid coupling- clutch repairs and adjustments- clutch slips and clutch does not engage	1, 3
8	Tractor gear box-classification-selection and its constructional details-sliding mesh, constant mesh and synchromesh gear box- components and working principle	1, 3
	Unit 3	
9	Numericals on calculation of indicated horse power, brake horse power and frictional horse power- Calculation of gear ratio of different gear boxes	1, 3
10	Torque converter -components and working principle	1, 3
11	Differential unit and final drive- components of differential unit-functions of crown wheel- differential lock- operating principle of differential unit and final drive	1
12	Tractor steering unit- components- operation-types of steering boxes-worm and nut type- worm and wheel type- worm and sector- working principle and constructional details	1, 3
	Unit 4	
13	Hydraulic steering- components- working principle and maintenance	1, 3
14	Tractor brake systems- mechanical- internal expanding and external contracting type- disc type hydraulic brake system- components and constructional details- operation	1
15	Fuel system- quality of fuel- fuel tests- precautions in handling fuel system- trouble shooting- process to remove airlock in diesel engine-precautions in handling diesel engine	1
16	Hydraulic system- functions- components- cylinder- pump, tank, control valve, filter- working principle- position control system- draft control systems- mixed control system	1
	Unit 5	
17	Precautions, repairs and maintenance of hydraulic systems, hitch types-drawbar hitch and three point hitch	1
18	Ratchet and pawl arrangement – construction details- principles- working	1

19	Crawler type tractor- characteristics- components and operation mechanism	1
20	Tractor control board-main switch-throttle lever-de compression lever-hour meter-light switch- temperature gauge and its functions	1
	Unit 6	
21	Terminology related to tractor tyres- chassis- functions and maintenance of chassis	1, 3
22	Front axle- toe in-toe out- caster angle- camber angle, track width and wheel base- rim pull	1, 3
23	Traction and traction theory- rolling resistance- soil pressure- wheel slip-cohesion of soil and its related problems- traction improving methods; Ballasting; Cage wheels	1
24	Tractor power outlets- PTO power- belt pulley- drawbar power; Introduction to tractor hitching system- single point hitch and three Point hitch	1, 3
	Unit 7	
25	Tractor centre of gravity- introduction to centre of gravity- methods of measurement- suspension, balancing and weighing method	1
26	Tractor testing- preparation for tests- types of tests- essential tests- main PTO test, belt or pulley shaft test, engine test and drawbar test	1, 2
27	Starting and operating of a tractor- method of starting and stopping a tractor- precautions while starting and operating tractor	1
28	General troubles- repair, maintenance of tractor- cooling system, lubrication system, ignition system, hydraulic system and power transmission system- storage of tractor	1
	Unit 8	
29	Periodical maintenance of tractors at 8 to 10 hours, 50-60 hours, 100-120 hours, 200 to 250 hours, 480-500 hours and 960-1000 hours	1
30	Tools used in repair and maintenance of tractor-ring, open end spanner, sockets, ranches, pliers, hammers and punches	3
31	Mechanical power transmission methods- belt drive, chain and sprocket drive- gear drive and their functions	1
32	Mechanical power transmission methods- types of gears- spur gear, helical gear, worm gear, bevel gear, spiral gear and their functions	1

Practical's

1	To identify different functional systems in the tractor and their components
2	To study the constructional details of different friction clutches
3	To study the constructional details of gear boxes of tractor
4	To study the constructional details of differential, differential lock and final drive system in the tractor
5	To study the constructional details of steering system in the tractor
6	To measure the toe in, caster angle, camber angle and wheel base of tractor
7	To measure the wheel slip of two wheel drive and four wheel drive tractor
8	To study the constructional details of different brake systems in the tractor

9	To operate different implements using different power outlets in the tractor
10	To study the engine trouble shooting, causes and remedial measures
11	To study the cooling system in the tractor and procedure for radiator flushing in different tractors
12	To study the different types of gears in mechanical power transmission
13	Driving practice for familiarization with different controls
14	Driving practice for familiarization with different controls
15	Driving practice for familiarization with different controls
16	Brief review of practical's carried out

References

1. Elements of Agricultural Engineering, Jagadishwar Sahay, 1992. Standard Publishers and Distributors, New Delhi.
2. Farm tractor maintenance and repair, Jain S. C. and Rai C. R., Standard Publishers and Distributors, New Delhi.
3. Farm Machines and equipment, Nakra C. P., 2016. Dhanpat Rai Publishing Company, New Delhi.

DAE 312 Operation and Maintenance of Farm Machinery 2 (0+2)

Objective To impart knowledge and skill to students for attaining all important parts and working principles of all farm machinery.

Practical's

1	Study of mould board plough (Dismantling)
2	Study of mould board plough (Assembling)
3	Study of disc plough (Dismantling)
4	Study of disc plough (Assembling)
5	Study of disc harrow (Dismantling)
6	Study of disc harrow (Assembling)
7	Study of rotary tiller (Dismantling)
8	Study of rotary tiller (Assembling)
9	Study of five tyne cultivator
10	Study of seven tyne cultivator
11	Study of mechanical weeders
12	Study of weeder (Assembling and dismantling of Cono weeder)
13	Study of sprayer (Knapsack)
14	Study of sprayer (Knapsack)
15	Study of sprayer (Hand compression)
16	Study of sprayer (Hand compression)
17	Study of sprayer (Rocking)
18	Study of sprayer (Rocking)
19	Study of duster (Hand rotary)
20	Study of duster (Hand rotary)

21	Study of sprayer (Power operated mist blower cum duster)
22	Study of sprayer (Power operated mist blower cum duster)
23	Study of sprayer (Taiwan type)
24	Study of sprayer (Taiwan type)
25	Study of sprayer (Foot)
26	Study of sprayer (Foot)
27	Study of sprayer (Stirrup)
28	Study of blade harrow (Tractor and animal Drawn)
29	Study of ridger
30	Study of bund former (Tractor and animal drawn)
31	Study of bund former (Tractor and animal drawn)
32	Brief review of practical's carried out

References

1 Elements of Agricultural Engineering, Jagadishwar Sahay, 1992, Agro Book Agency, Patna.

DAE 313 Farm Power, Solar, Wind and Bio-Energy 2 (1+1)

Objective To gain knowledge on sources of farm power, conventional and non-conventional energy sources, concepts of utilization of non-conventional energy resources to effectively utilize the energy for agricultural operations and agricultural processing activities.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Farm power: Sources of farm power- human power- animal power- mechanical power- electrical power- renewable energy	4
2	Renewable sources of energy: Introduction – need –types of renewable sources of energy; Solar energy; Wind energy; Biomass energy; Tidal energy; Hydrogen; Fuel cell	1
	Unit 2	
3	Solar Energy: Introduction– solar constant– solar radiation at the earth's surface– beam and diffused solar radiation– measurement of solar radiation– Pyrheliometer– Pyranometer and Sunshine recorder	1
4	Solar energy collection: Principle of conversion of solar radiation into heat– solar collectors– flat plate collectors– solar liquid flat plate collector – solar air flat plate collector	1
	Unit 3	
5	Concentrating collectors: Line focusing collectors – point focussing collectors – non-focusing type – flat plate collector with adjustable mirrors – advantages and limitations of concentrating collectors	1
6	Solar energy storage: Classification of solar energy storage system; Thermal energy storage; Sensible heat storage; Latent heat storage; Thermo-chemical energy storage; Solar pond– working principle of solar pond – applications of solar pond	1

	Unit 4	
7	Solar energy applications: Solar water heater; Natural circulation type (Pressurised); Forced circulation type– design, principle and constructional details of box type cooker – advantages and limitations	1
8	Photo voltaic conversion: Solar cell – working principle– conversion efficiency and power output of a solar cell – applications – advantages and disadvantages of photovoltaic solar energy conversion	1
	Unit 5	
9	Photo voltaic cell for power generation: Solar photovoltaic water pumping system: Solar street lighting	1, 2
10	Wind energy: Introduction – basic components of a wind energy conversion system	1
	Unit 6	
11	Classification of wind energy conversion systems: Horizontal axis wind mill; Vertical axis wind mill	1
12	Wind Data and Energy Estimation: Site selection considerations – power Coefficient – electrical generation in a wind mill	1
	Unit 7	
13	Characterization of biomass: Biomass conversion technologies, problems associated with biomass and its conversion technologies, classification of biomass, sources and characteristics of biomass	1, 3
14	Biogas plants: Introduction, anaerobic digestion, phases of anaerobic digestion – advantages of anaerobic digestion, factors affecting bio-digestion types of microorganisms	1
	Unit 8	
15	KVIC biogas plants: Janata type biogas plants— comparison between Janata type and KVIC type plants	1
16	Deenabandu biogas plant: Materials used for biogas generation– applications of biogas– biogas requirement for different applications	1

Practical's

1	To study the instruments - Pyrheliometer and Pyranometer for the measurement of solar radiation
2	To study different types of solar non concentrating flat plate collectors- liquid and air collectors
3	To study of different types of solar concentrating collectors – Focusing and non-focusing type
4	To study the solar pond and its applications
5	To study the solar water heater and solar cooker
6	To study the photovoltaic cell
7	To study the solar PV power generation and water pumping system
8	To study the solar street light, solar lantern and solar fencing
9	Wind mill for water pumping and power generation
10	To study the horizontal axis wind mills
11	To study the vertical axis wind mills

12	To study the electrical generation in a wind mill
13	To study the KVIC and Janata biogas plant
14	To study the Deenabandhu biogas plant
15	To study the biogas requirement for different applications
16	Brief review of Practical's carried out

References

1. Non-Conventional Energy Sources Rai G. D.,1984. Khanna Publishers, New Delhi.
2. Solar Energy Utilization Rai G. D., 1984. Khanna Publishers, New Delhi.
3. Biotechnology and other Alternate Technology Chakravarthy A., 1989. Oxford and IBH Publishing Co Ltd, New Delhi.
4. Elements of Agricultural Engineering Jagdishwar Sahay, Standard Publishers & Distributors, New Delhi.

DAE 321 Greenhouse Technology 2 (1+1)

Objective Study of constructional and operational details of greenhouses will lead the students to grow crops with profits and also to use the greenhouses for offseason usage and also to manage them commercially.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Introduction to greenhouses - history, definition, greenhouse effect, advantages of green houses	1, 2, 3 and 4
2	Brief description of types of greenhouses - greenhouses based on shape, utility, construction, covering materials and costs- shade nets	1, 2, 3 and 4
	Unit 2	
3	Plant response to greenhouse environments - light, temperature, relative humidity, ventilation and carbon dioxide	1, 2, 3 and 4
4	Environmental requirement for agriculture and horticulture crops inside green houses: Light requirement of crops and light control methods; Greenhouse shading methods; Greenhouse supplemental lighting systems	1, 2, 3 and 4
	Unit 3	
5	Environmental control inside greenhouse- manual controlling, thermostats, Active summer cooling systems, active winter cooling systems, carbon dioxide enrichment methods	1, 2, 3 and 4
6	Equipment required for controlling greenhouse environment- natural ventilation, forced ventilation, microprocessors and computers and advantages of computerized control systems	1, 2, 3 and 4
	Unit 4	
7	Planning of green house facility - site selection and orientation, structural design and covering materials	1, 2, 3 and 4
8	Materials for construction of greenhouses - wood, galvanized iron, glass, polyethylene film, poly vinyl chloride film, Tefzel T^2 film, fiberglass reinforced plastic rigid panel and acrylic and polycarbonate rigid panel	1, 2, 3 and 4

	Unit 5	
9	Design criteria and constructional details of greenhouses: Construction of glass greenhouses and pipe framed greenhouses, material requirement, preparation of materials and procedure of erection	1, 2, 3 and 4
10	Greenhouse cooling: Design of active summer and winter cooling systems	1, 2, 3 and 4
	Unit 6	
11	Greenhouse heating: Modes of heat loss, heating systems, heat distribution systems, solar heating system, water and rock storage, heat conservation practice	1, 2, 3 and 4
12	Irrigation system used in greenhouses: Rules of watering, hand watering, perimeter watering, overhead sprinklers, boom watering and drip irrigation	1, 2, 3 and 4
	Unit 7	
13	Greenhouse utilization in off-season, drying of agricultural produce and curing of tobacco	1, 2, 3 and 4
14	Simplified protected agricultural techniques: Row covers, perforated plastic channels, Slitted row covers, air supported row covers, floating row covers	1, 2, 3 and 4
	Unit 8	
15	Advanced protected agricultural systems: Hydroponic system, functions, advantages and disadvantages and nutrient film technique	1, 2, 3 and 4
16	Economic analysis of greenhouse production: Capital requirement, economics of production and conditions influencing returns	1, 2, 3 and 4

Practical's

1	Study of covering and construction materials for greenhouses
2	Measurement of environmental parameters inside greenhouse
3	Study of construction of pipe framed greenhouses
4	Calculation of ventilation rates- Rate of air exchange in active summer cooling system- Problems on fan and pad cooling system
5	Rate of air exchange in active winter cooling systems – Problems on convection tube cooling
6	Heat requirement calculation- heat requirement of A-frame greenhouse-Problems
7	Heat requirement calculation- heat requirement of Quonset type greenhouse – Problems
8	Study of drip irrigation system in greenhouse
9	Estimation of drying rate of agricultural produce inside greenhouse
10	Study of different protected agriculture techniques
11	Exercise on cost economics of greenhouses
12	Field visit to glass greenhouses
13	Field visit to polyhouses
14	Field visit to semi control greenhouses
15	Field visit to fully controlled greenhouses
16	Brief review of practical's carried out

References

1 Greenhouse Technology and Management, Radha Manohar K. and Igathinathane C., 2017. BS Publication, Hyderabad.

2 Greenhouse Technology, Tiwari G. N. and Goyal R. K., 1998. Narosa Publishing House, New Delhi.

3 The complete Book of Greenhouse Gardening, Cavendish M., 1991. Marshal Cavandish Books Ltd , London.

4 Greenhouse Technology for Controlled Environment, Tiwari G. N., 2012. Narosa Publishing House Pvt Ltd New Delhi.

DAE 331 Hydrology and Management of Watersheds 2 (1+1)

Objective To impart knowledge and skills to students on rainfall, runoff and hydrological aspects, watershed concepts, stream flow measurements in watersheds, prediction of runoff volumes with hydrographs and unit hydrographs, effective resources management in watersheds, monitoring and evaluation of watershed projects.

Theory :

Lecture No.	Contents	References
	Unit 1	
1	Hydrology – definition, hydrologic cycle and its components, forms of precipitation-Rain, snow, drizzle, glaze, sheet and hail; Types of formation of precipitation- convective precipitation and orographic precipitation, frontal precipitation and cyclonic precipitation; Characteristics of rainfall in India; Types of monsoon: South West, North East (transition-I), winter season and summer pre-monsoon rains (transition- II)	1, 2
2	Typical rain chart used in natural syphon gauge: Installation of rain gauges; Rain gauge network density for different topographic (flat, mountains, plains and hilly areas) conditions; Adequacy of rain gauge stations	1, 2
	Unit 2	
3	Probability analysis of rainfall: Return period or recurrence interval-definition and explanation; Plotting position by Weibull's method, relation between plotting position and return period, rainfall events at different probability levels (20, 40, 60, and 80%)	1, 2
4	Runoff – definition – components of runoff – direct runoff and base flow, overland flow and interflows, their definitions based on time delay between rainfall and runoff and pictorial representation of different routes of runoff Factors affecting runoff- climatic factors (Type of rainfall, rainfall intensity, duration and distribution, direction of the storm Physiographic factors (size, shape, slope, watershed orientation, land use, soil moisture and soil type)	1, 2
	Unit 3	
5	Runoff characteristics of streams – perennial, intermittent and ephemeral streams, measurement of stream flows: methods of direct and indirect determination of stream flow, catchment characteristics - size, shape, slope, relief, drainage density, compaction coefficient, hypsometric curve	1, 2

6	Measurement of stage and velocities in streams: Area – velocity method; staff gauge, point gauge, automatic stage recorders, floats and Stevens Type-F recorder, current meters (Horizontal and vertical axis), typical linear empirical relation between velocity and number of revolutions per second, calibration; Area-Velocity method- typical stream section for area-velocity method of stream flow determination	1, 2
	Unit 4	
7	Hydrographs: Definition and components, rising limb, falling limb and crest segments in hydrograph and factors affecting their shapes, elements of a flood hydrograph showing direct runoff and base flow; Factors affecting flood hydrographs- physiographic factors (catchment characteristics, infiltration characteristics and channel characteristics) and climatic factors (storm characteristics, initial losses and evapotranspiration)	1, 2
8	Unit Hydrographs: Conceptual theory and definition and explanation of the two basic assumptions (linear response and time invariance), derivation of a unit hydrograph from simple storms, uses and limitations of unit hydrographs	1, 2
	Unit 5	
9	Application of Hydrology: Flood control- definition and classification of floods (design flood, standard project flood, maximum probable flood, peak flood, maximum observed flood, annual flood and ordinary flood) (definitions only), flood mitigation and control measures (List of structural and non-structural measures), effect of watershed management practices on reduction in flood peaks (explanation through figure only)	1, 2
10	Watershed: Definition, identification and delineation, Physiographic characteristics of watershed – area, coefficient of compactness, slope, shape factor, drainage density, relief, ruggedness and hypsometric curve; Importance of these characteristics in watershed management	2, 5
	Unit 6	
11	Principles and objectives of watershed management, Summary of watershed management plans prepared by Central soil and water conservation research and training institute, Dehradun	3
12	Watershed management case studied: Operational research projects- Fakot, Sukhomajri and Chitradurga	3
	Unit 7	
13	Components of watershed management: Land management (structural measures, vegetative measures, production measures and protection measures); Water management (rain water harvesting, ground water recharge, maintenance of water balance, prevention of water pollution); Biomass management	5
14	Watershed and people: Introduction, definition of peoples participation, Rationale of people's participation, factors affecting people's participation, provision of incentives for people's participation, mobilization of people's participation	4

Unit 8

15	Formulation of participatory watershed development and management project, strategies for strengthening field implementation, for transfer of technology, for financial control Strategies for farmers participation, strategies for proper maintenance of water sheds, format for planning of watersheds	4
16	Monitoring and evaluation of watershed projects: Monitoring and evaluation systems, monitoring and evaluation methodology and follow-up; Identification of constraints – budgetary, manpower, mobility and equipment, technical information, farmers participation, policy constraints	4

Practical's

1	Hydrologic cycle
2	Study of recording rain gauge
3	Visit to meteorological station
4	Rainfall probability by Weibull's method
5	Study of current meter
6	Problems on stream flow measurement
7	Problems on hydrograph
8	Analysis of runoff hydrograph
9	Computation of peak rate of runoff (Rational method only)
10	Computation of volume of runoff
11	Derivation of unit hydrograph
12	Delineation of watershed
13	Determination of watershed characteristics
14	Visit to watershed
15	Visit to watershed
16	Brief review of practical's carried out

References

1. Engineering Hydrology, Subramanya K., 2013. Tata McGraw Hill Publishing Co Ltd, New Delhi.
2. Watershed Hydrology, Suresh R.,1997. Standard Publishers and Distributors, New Delhi.
3. Watershed Management, Dhruva Narayana V.V., Sastry G, Patnaik U.S.,1997. ICAR, New Delhi.
4. Watershed planning and Management, Raj Vir Singh, 2000. Yash Publishing House, Pawanpuri, Bikaner.
5. Soil and Water Conservation Engineering Suresh R., 1997. Standard Publishers and Distributors, New Delhi.

DAE 341 Estimating and Costing of Farm Buildings and Structures 2 (1+1)

Objective The student will be acquainted with various types of farm buildings, structures, basic building materials, their specifications, estimating and costing procedures, their construction and various enterprises related the farm structures**.**

Theory

Lecture No.	Contents	References
	Unit 1	
1	Farmstead: Definition and constitution – various types of buildings and structures in a farmstead in the developed countries and in India	1, 2, 3
2	Planning and layout of farmstead: Location and arrangement of various farm buildings – factors effecting planning of farmstead- principles to be followed in locating positions of various structures based on sanitation and other requirements	1, 2, 3
	Unit 2	
3	Design of animal shelters: Dairy barns – face in and face out type of barns- their advantages and limitations- stanchion aspects of the barn, loose housing barn- familiarization of terminology like gutter, stanchion, manger, feed alley and milking parlor- equipment in dairy barns for cleaning and milking	1, 2, 3
4	Design of animal shelters: Poultry housing – Deep litter system, cage system and wire mesh floor system – roofs - perches - brooder houses – equipment in poultry houses - type of litter materials to be used	1, 2, 3
	Unit 3	
5	Design of animal shelters: Sheep and goat housing – traditional and modern shelters-sheep and goat pens - types of construction materials	1, 2, 3
6	Construction of farm buildings: Foundation – basis for width of foundation – bearing pressure of soils – material used for foundation; Super structure – walls and columns, bearing and non-bearing walls – materials used for construction of walls and columns	2, 3
	Unit 4	
7	Construction of farm buildings: Roof – types of roofs, roof support structures -trusses, rafters, purlins- materials used for trusses- RCC roofs and beams; flooring- requirements of flooring, types of floors	3, 4
8	Building materials: Cement – constitution of cement, properties; Lime – preparation of lime for construction – calcination and hydration, quick lime, slaked lime; sand – properties, importance of sand in construction	3, 4
	Unit 5	
9	Building materials: Concrete – constitution – plain and reinforced cement concrete – aggregates - computation of quantities of constituents using Fuller's formula –curing of concrete; use of steel as building material- various mixes and their utility	3, 4
10	Bricks: Making of bricks – quality of bricks – treatment of bricks before using in construction; Timber - various types of timber used in building construction, properties and seasoning of timber	3, 4
	Unit 6	
11	Design of storage structures: Density of various silage- estimating requirement of silage – process of ensiling – various types of silos – tower, pit and trench silos and their adaptability- design of silo- storage life of silos for the usage without spoilage	1

12	Design of storage structures: Grain storage – requirements of storage of grain –types of storage – bulk storage and bag storage – design of go down based on the size of bags, material to be stored, spacing of stacks and structure of grain bins- types of traditional storage structures and their constructional details	1
	Unit 7	
13	Farm fencing, roads and threshing yard: Various types of fences – wire fence and power fence – oven wire fencing- barbed wire fencing and size specification such as gauge and estimating cost of fencing; farm roads- requirement and types of roads – water bound macadam and tar bound macadam – construction of roads Design and construction of threshing yard	1
14	Quantity survey: Estimation of quantities of various items of construction from a drawing of a structure – approximate and preliminary estimates - center line method – calculation of quantities- abstract estimate - specifications of quantities like running meters, cubic meters, square meters and no's - revised estimates - modified estimates	4
	Unit 8	
15	Quantity survey: Costing of various items of construction – analysis of rates – standard schedule of rates - based on the prevailing local conditions like earthwork unit rates- filling unit rates- transportation - lead rates of earth or soil - requirement of material and labour for various items of construction – abstract estimate - sample estimate for a civil work	4
16	Government Schemes on promotion of dairy and poultry enterprises, rural go downs and cold storages: Farm machinery sheds – components of machinery sheds and requirement and constitution of farm workshop based on size of the farming enterprise - types of floor plans - requirements for ramp	4

Practical's

1	Knowledge on requirement of building drawing – making a sketch based on requirements of space and ventilation
2	Drawing to scale of the building – plan, elevation and sectional view depicting details of foundation, walls and roof
3	Design of fencing - working out cost of fence for a given area
4	Design of feed storage structure – silo
5	Study of stanchion barn
6	Study of poultry housing
7	Estimating quantities of items of construction – problems on centerline method
8	Estimating quantities of items of construction – problems on centerline method
9	Preparation of detailed estimate for a farm building
10	Preparation of detailed estimate for a farm building
11	Preparation of abstract estimate: Analyses of rates - working out rates of various items of construction
12	Preparation of abstract estimate: Analyses of rates - working out rates of various items of construction

13	Understanding of grain storage structure: Problems on design of godown based on bag storage
14	Visit to study of grain storage structures and design of a godown
15	Visit to study of dairy farm / poultry farm
16	Brief review of practical's carried out

References

1. Principles of Agricultural Engineering Vol.-I, Michael A. M. and Ojha T. P., 2004. Jain Brothers, New Delhi.
2. Agricultural Buildings and Structures, Whitaker J., 2002. Publishing Home, Reston, Virginia.
3. Farm Buildings Design, Newbaver L. W. and Walker H. B., 2003. Prentice Hall Inc, New Jersey.
4. Indian Practical Civil Engineer's Hand Book, Khanna, P. N., Engineers' Publishers, New Delhi.

DAE 351 Principles of Agricultural Economics and Business Management 2 (1+1)

Objective Economic principles related to agriculture give the students emphasis on farm business management, analysis of budgeting, credit analysis, market management, export strategies. Confidence in students will be strengthened to start up their individual firm.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Agricultural economics: Meaning, nature and scope and importance of economics and agricultural economics, micro economics and macroeconomics, basic economic problems	1, 2
2	Agricultural production economics: Definitions, nature and scope, subject matter of agricultural production economics, objectives of production economics and relationship with other Sciences	1, 2
	Unit 2	
3	Farm management: Meaning, definition, nature and scope, relationship with other sciences; Why study farm management- farm management decisions; Economic principles applied to organization of farm business	1, 2
4	Law of variable proportions: Definition, tabular and graphical explanation with examples and its importance in factor; Product decision making	1, 2
5	Farm budgeting: Meaning, types of budget, partial budgeting, enterprise budgeting and whole farm budgeting	1, 2
	Unit 3	
6	Agricultural credit: Meaning and definition of credit-classification of credit based on various criteria, role of credit, capital in farm business	1
7	Credit analysis: Economic feasibility tests; Five Cs and Three Rs of credit analysis; Economic feasibility tests of credit	1

	Unit 4	
8	Agricultural marketing: Definition - meaning - components of market;- Importance of agricultural marketing in economic development – classification of markets	1, 3
9	Marketing functions: Meaning, assembling, packing, grading and standardization, transportation, storage, processing, distribution, buying and selling, market financing, marketing intelligence, market information and risk management	1, 3
	Unit 5	
10	Management: Definition, decision management, importance of management, concepts and management wheel diagram	4, 5
11	Management functions: Planning, organization, direction, control, coordination and communication	4, 5
	Unit 6	
12	Agribusiness management: Meaning, definition, concept, distinctive features of agribusiness management, application of management principles in agri-business	4, 5
	Unit 7	
13	Agro-based industries: Importance, need, classification of agro based industries; Procedure to be followed to set up agro-based industries; Constraints in establishing agro-based industries	4, 5
	Unit 8	
14	Project Analysis: Project meaning, project cycle- identification, formulation, appraisal, implementation, monitoring and evaluation	6
15	Project appraisal techniques: Undiscounted measures-payback period; Rate of return / Return on Investment	6
16	Discounted techniques: Net Present Value (NPV); Benefit Cost Ratio (BCR); Internal Rate of Return (IRR) and Sensitivity analysis	6

Practical's

1	Farm holding survey using structured schedules
2	Farm holding survey using structured schedules
3	Methods of estimation of depreciation
4	Seven production costs-variables cost, fixed costs, marginal cost, total cost –examples and estimation- decision making rules
5	Seven production costs-variables cost, fixed costs, marginal cost, total cost –examples and estimation- decision making rules
6	Project formulation
7	Project evaluation techniques: Undiscounted and discounted techniques
8	Project evaluation techniques: Undiscounted and discounted techniques
9	Project evaluation techniques: Undiscounted and discounted techniques
10	Profit and loss statement
11	Balance sheet statement
12	Financial test ratio's

13	Estimation of marketing costs, marketing margins and price spread
14	Break even analysis
15	Visit and study of an agri-business enterprise/agro industry
16	Brief review of practical's carried out

References

1. Agricultural Economics, Subba Reddy S., Raghu Ram P., Neelakantha Sastry T. V. and Bhavani Devi P., 2004. Oxford and IBH Publishing Co Pvt, Ltd, New Delhi.
2. Economics of Farm Production and Management, Raju V. T. and Rao D. V. S., 1990. Oxford and IBH Publishing Co Pvt Ltd, New Delhi.
3. Agril-Marketing in India, Acharya S. S. and Agarwal N. L., 2005. Kalyani Publications.
4. Essentials of Management , Joseph L Massie, 1995. Pretice- Hall of India, New Delhi.
5. Agricultural Economics and Agri-business, Omri Rawlins N., 1980. Prentice-Hall Inc.
6. Economic Analysis of Agricultural Projects, Gittinger Price J., 1989 World Bank, John Hopkins University Press, London.

DAE 352 Agricultural Engineering Extension Methods 1 (0+1)

Objective To provide hands on experience in conducting certain extension methods using audio visual aids for effective transfer of technology from workshops to the farmers fields.

Practical's

1	Extension teaching methods: Meaning – classification of extension methods according to Wilson and Gallup. According to use (Individual, group, mass contact methods), According to form (Written, spoken, visual and spoken & visual) and simulated exercise on communication
2	Group discussion: Purpose, procedure, role of chairman (do's and dont's), role of members, advantages and disadvantages; Planning for group discussion in class room
3	Conduct of group discussions in class room by the students and analysis
4	Audio- Visual Aids: Audio aids, visual aids (Projected and non projected): Audio Visual Aids - poster, charts and graphs – planning and preparation of charts (Time, flow, tree and flip) and graphs (Bar, pie, line and flannel)
5	Small group discussion techniques – lecture/extension talk, debate, symposium, panel, forum, buzz, workshop, brainstorming, seminar, conference simulated exercise on debate, buzz session and planning for extension talk and practice by the students
6	Extension talk using non projected visuals in class room
7	Practical on debate and brainstorming by the students in class room
8	Method demonstration – Basis for demonstration, purpose, procedure (Analyse the situation – plan – rehearse – demonstrate - follow up), advantages and limitations; Planning for conduct of method demonstrations
9	Practical on method demonstrations by the students in class room and analysis
10	Exhibition: Purpose, procedure (Planning, preparation, implementation and follow up), advantages and limitations; Planning for preparation of models and working models by the students
11	Visit to information centre in a research station/college/KVK/DAATTC
12	Practical on conducting exhibition in class room with different exhibits

13	Information materials – Planning and preparation of leaflet, folder and pamphlet
14	Audio aids: Public address system and telephone calls; Kisan call centre - handling of Public address system
15	Power Point slides: Planning and preparation of power point slides for effective presentation and handling LCD projector
16	Power Point presentations by the students in class room

References

1. Extension Education, Adivi Reddy A., 1997. Sree Lakshmi Press, Bapatla.
2. Communication and Extension Management, Ray G.L., 2006. Kalyani Publishers, Hyderabad.
3. Communication and Extension Management, Jitendra Chauhan, 2016. Kushal Publications and Distributors, Varanasi.
4. Dimensions of Agricultural Extension, Singh A. K., Lakhan Singh, Roy B. R., 2018. Rama Publishing House, Meerut.
5. Agricultural Extension, Van den ban A. W. and Hawkins H. S., 2002. CBS Publishers and Distributers Pvt Ltd, New Delhi.

DAE 353 Introduction to Environmental Science and Disaster Management 1 (1+0)

Objective To make awareness among the students the importance of the environmental aspects of engineering systems and how effectively the environment can be protected from evil pollutants with knowledge on the cause of pollution and issues biodiversity, disaster management and environment protection acts.

Theory

Lecture No.	Contents	References
	Unit 1	
1	Multidisciplinary nature of environmental studies:Definition, scope and importance	1
2	Natural resources: Renewable and non-renewable resources; Forest resources: Functions of forests, causes and consequences of deforestation	1
	Unit 2	
3	Water resources: Sources, use and over utilization of surface and ground waters; dams – benefits and problems Sustainable management of water; Food resources: World Food problems, food resources, food security	1
4	Energy resources: Renewable and non-renewable energy resources, their impact on environment; Land resources: Land use planning, land degradation and desertification; Role of an individual in conservation of natural resources	1
	Unit 3	
5	Biodiversity: Definition, types of biodiversity, bio-geographical classification of India	1
6	Biodiversity: Hot spots of biodiversity, threats to biodiversity, habitant loss, poaching of wild life, man-wildlife conflicts, endangered and endemic spices of India	1

	Unit 4	
7	Biodiversity: Conservation of biodiversity- *in situ* and *ex situ* methods of measuring biodiversity; Biodiversity Act, functions of National Biodiversity Authority	1
8	Environmental pollution: Causes, effects and control measures of soil, water and air pollution, tolerable limits of toxic gases in air	1
	Unit 5	
9	Solid waste management: Causes, effects and control measures agricultural wastes, Urban and industrial wastes- 3R'S- Role of individuals in prevention of pollution	1
10	Social issues of environment, un-stainable to sustainable, developments, urban problems related to energy, water conservation, rain water harvesting and watershed management	1
	Unit 6	
11	Climate change, sea level rise, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust	1
12	The Environment protection Act: The air (Prevention and control of pollution) Act; The Water (Prevention and control of pollution) Act; The Wildlife Protection Act ; The Forest Conservation Act	1
	Unit 7	
13	Human population and the Environment: Population growth, variation among nations, population explosion and family welfare programmes woman and child welfare, HIV/AIDS	1
14	Disaster management: Natural disasters and nature of the natural disasters, their types and effects- Floods, drought, cyclones and earthquake	1
	Unit 8	
15	Manmade disasters: Nuclear disasters, chemical disasters, biological disasters, building/coal/ forest/ oil fire, water pollution, deforestation and industrial waste pollution	1
16	Disaster management and mitigation: Concept- role of NGO's, community based organizations, media, centre, state, district and local administration, armed forces, police and other organizations in disaster response	1

References

1. Principles of Environmental Studies, Chary Manohar and Jaya Ram Reddy, 2004. BS Publishers, Hyderabad.
2. Introduction to Environmental Science, Sharma J. P., 2003. Lakshmi Publications.
3. Natural Disaster, Sharma R. K. and Sharma G., 2005. APH Publishing Corporation, New Delhi.
4. Adaption and mitigation of climate change, Scientific Technical Analysis,1995. Cambridge University Press, Cambridge.

Student READY

Rural and Entrepreneurship Awareness Development Yojana

DAE 361 Participatory Technology Training Programme 12 (0+12)

Students has to undergo student READY skill development training for 2 months duration (one training of two months in one organization or two trainings of one month each in two different organizations) in Micro Irrigation/ Watershed programmes/ Agricultural Processing/ Farm Mechanisation/Custom hiring in related industries/research organizations/NGO's with credit load of 12 credit hours. At the end of training programs students submit the training report to the respective Polytechnics.

DAE 362 Project Work 05 (0+5)

During the Project work, the students of polytechnics make a brief case study related to any Agricultural Engineering topic related to Watersheds, irrigation systems and crop water management, different crop processing's techniques, Farm machanization tools and equipment utilization and energy related issues and submit the study report to the respective Polytechnics.

Physical Education- Non Credit Courses

All the Polytechnics of Agricultural Engineering should provide the facilities and to conduct the following non credit courses for the benefit and development of students.

COCA 100 N C C 01(0+1)

National Cadet Corps (NCC) aims at development of character, discipline, comradeship, secular outlook, ideals of selfless services and adventure spirits amongst large numbers of young citizens. To create a pool of trained, organized and motivated youth with various leadership qualities in every walk of their live and serve the Nation irrespective of career they choose.

COCA 200 Physical Education 01(0+1)

To create the awareness to the students on different aspects of health and fitness and to learn good health habits. Exercises and games practice for good health and physique moment of body through different positions, postures, poses and games.

COCA 300 N S S 01(0+1)

To create awareness among students on National Social Service (NSS) programmes and to motivate them to understand the community, identify the needs and problems of the community and to develop a sense of social and civil responsibility, utilize their knowledge for finding the practical solution to the community problems and also to develop the capacity to meet the challenging tasks as well as to practice national integration and social harmony.

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Polytechnic of Agricultural Engineering students under learning and skill development process

Sustainable development through Skill development