ERODE SENGUNTHAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University)

PERUNDURAI, ERODE - 638 057

UG Curriculum and Syllabus

(1 to 8 Semesters)

B.E – AGRICULTURE ENGINEERING

Choice Based Credit System (CBCS)

REGULATION 2019

B. E. AGRICULTURE ENGINEERING
REGULATIONS– 2019
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULUM

Induction Program (Mandatory)	3 weeks duration
Induction program for students to be offered right at the stat of the first year	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept. / Branch & Innovations

B.E. AGRICULTURE ENGINEERING
Total Credit : 165

SEMESTER I

THEORY

Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS101	Calculus and its Applications	I ,III	1,2,3, 4,12	1	3	1	0	4	40	60	100	BS
19BS102	Engineering Physics	I ,III	1,2,4, 5,6,8, 9	1	2	0	2	3	40	60	100	BS
19BS103	Engineering Chemistry	I ,III	1,2,3, 4,5,7, 12	1	3	0	0	3	40	60	100	BS
19HS101	Communicative English	III	2,3,6, 9,10,1	1	3	0	0	3	40	60	100	HS
19ES102	Basics of Electrical and Electronics Engineering	I ,III	1,2,3, 4,9	1	2	0	2	3	40	60	100	ES
19TPS01	Soft Skills - I	III	8,9,10 ,12	1	1	0	0	1	40	60	100	EEC
PRACTICAL												
19ES106	Engineering Graphics	II	1,2,3,5 ,10,12	2	0	0	4	2	60	40	100	ES
19ES107	Workshop Practices	II	1,3,9, 12	3	0	0	2	1	60	40	100	ES
TOTAL					14	1	11	20	360	440	800	-

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SEMESTER II												
THEORY												
Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS201	Vector Calculus and Complex Variables	I ,III	1,2,3, 4,12	1	3	1	0	4	40	60	100	BS
19BS209	Applications of Physics to Agriculture Engineers	I ,III	1,5,7	1	3	0	0	3	40	60	100	BS
	Language Elective	III	2,3,6, 9,10,1 2	1	3	0	0	3	40	60	100	HS
19ES201	Problem Solving and Python Programming	II	1,2,3, 4,5	1	3	0	0	3	40	60	100	ES
19ES209	Mechanics for Engineers	II	1,2,3, 4,6,7, 8,9,10	1	3	0	0	3	40	60	100	ES
19MC201	Environmental Science and Engineering	I ,III	1,2,3, 4,5,6, 7,8,12	1	3	0	0	0	40	60	100	MC
19TPS02	Soft Skills - II	III	8,9,10 ,12	1	1	0	0	1	40	60	100	EEC
PRACTICAL												
19ES214	CAD for Agricultural Engineering	II	1,5,6	2	0	0	4	2	60	40	100	ES
19ES213	Problem Solving and Python Programming Laboratory	II	1,2,3, 4,5,12	1	0	0	2	1	60	40	100	ES
19BS208	Engineering Chemistry Laboratory	I ,III	1,2,3, 4,5	1	0	0	4	2	60	40	100	BS
TOTAL					19	2	11	22	460	540	1000	-

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SEMESTER III												
THEORY												
Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS303	Transform Techniques and Partial Differential Equations	I ,III	1,2,3, 4	1	3	1	0	4	40	60	100	BS
19CE301	Mechanics of Solids	I, III	1,2,3, 4,6	1	3	0	0	3	40	60	100	PC
19ES309	Fluid Mechanics and Machineries	I, III	1,2,3, 4,5,6, 7,8,10 ,12	1	3	0	0	3	40	60	100	ES
19CE302	Surveying	I,III	1,4,5, 6,8,9, 11,12	1	3	0	0	3	40	60	100	PC
19AG301	Principles and Practices of Crop Production	II, III	1,5,7, 10,11, 12	1	3	0	0	3	40	60	100	PC
19ES310	Thermo dynamics	I ,III	1,2,3, 4,5,6, 7,8	1	2	2	0	3	40	60	100	ES
19MC301	Indian Constitution	IV	6,8,10 ,11,12	1	2	0	0	0	40	60	100	MC
19TPS03	Quantitative Aptitude and Logical Reasoning - I	III	1,2, 9,10, 12	1	2	0	0	0	40	60	100	EEC
PRACTICAL												
19CE304	Surveying Practical	III	1,2,10 ,11	1	0	0	4	2	60	40	100	PC
19HS301	Communication Skills	I	9,10	3	0	0	4	2	60	40	100	HS
TOTAL					21	3	8	23	440	560	1000	

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SEMESTER IV													
THEORY													
Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19BS401	Statistical Methods For Data Analysis	II	1,2,3, 4,5	1	3	1	0	4	40	60	100	BS
19AG401	Heat and Mass Transfer for Agriculture Engineers	I ,III	1,2,3, 4,5,6, 7,8	1	3	0	0	3	40	60	100	PC
19AG402	Farm Tractor Systems	I ,III	1,2,3, 4,5,6, 7,8	1	3	0	0	3	40	60	100	PC
19CE404	Water Resource and Irrigation Engineering	I ,III	1,2,3,5 ,6,7,8, 11,12	1	3	0	0	3	40	60	100	PC
19AG403	Mechanics of Farm Machines	II	1,2,3, 4,6,7, 8,9,10	1	3	0	0	3	40	60	100	PC
19HS402	Universal Human Values 2 : Understanding Harmony	I ,III	2,3,5, 6,8,11 ,12	-	2	1	0	3	40	60	100	HS
19TPS04	Quantitative Aptitude and Logical Reasoning - II	III	1,2, 9,10,1 2	1	2	0	2	0	40	60	100	EEC
PRACTICAL												
19AG404	Farm Tractors and Engines Laboratory	II	1,2,3, 4,5	1	0	0	4	2	60	40	100	PC
19AG405	Crop Production and Husbandry Laboratory	III	1,5,7, 10,11, 12	1	0	0	4	2	60	40	100	PC
19CE405	Hydraulics Engineering Laboratory	III	1,2,10 ,11	1	0	0	4	2	60	40	100	PC
TOTAL					20	1	10	25	460	540	1000	-

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SEMESTER V													
THEORY													
Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19ES501	Crop Process Engineering	I ,III	1,5,7, 10,11, 12	2	3	0	0	3	40	60	100	ES
19AG501	Farm Mechanization, Tillage and Sowing Equipment	I ,III	1,2,3, 4	1	3	0	0	3	40	60	100	PC
19AG502	Unit Operations in Agricultural Processing	II	1,2,3, 4,6,7, 8,9,10	2	3	0	0	3	40	60	100	PC
19AG503	Solar and Wind Energy Engineering	I ,III	1,5,7, 10,11, 12	1	3	0	0	3	40	60	100	PC
19AG504	Soil Mechanics for Agriculture Engineers	I ,III	1,5,7, 10,11, 12	2	2	0	2	3	40	60	100	PC
	Professional Elective - I				3	0	0	3	40	60	100	PE
19TPS05	Quantitative Aptitude and Logical Reasoning - III	III	1,2, 9,10,12	1	2	0	0	0	40	60	100	EEC
PRACTICAL												
19AG505	Operation and Maintenance of Farm Machinery Lab	II	1,2,3, 4,5	1	0	0	4	2	60	40	100	PC
19AG506	Crop Process Engineering Laboratory	II	1,2,3, 4,5	1	0	0	4	2	60	40	100	PC
TOTAL					8	0	8	22	400	500	900	

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SEMESTER VI												
THEORY												
Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PS Os					CA	ES	Total	
19AG601	Food and Dairy Engineering	I ,III	1,2,3,4	1	3	0	0	3	40	60	100	PC
19AG602	Plant Protection and Harvesting Machinery	I ,III	1,5,7, 10,11, 12	2	3	0	0	3	40	60	100	PC
	Professional Elective – II				3	0	0	3	40	60	100	PE
	Professional Elective – III				3	0	0	3	40	60	100	PE
	Open Elective - I*				3	0	0	3	40	60	100	OE
19TPS06	Quantitative Aptitude and Logical Reasoning - IV	III	1,2, 9,10,12	1	2	0	0	0	40	60	100	EEC
PRACTICAL												
19AG603	Irrigation Engineering Laboratory	I	9,10	3	0	0	4	2	60	40	100	PC
19AG604	Food Process Engineering Laboratory	I	9,10	3	0	0	4	2	60	40	100	PC
19AG605	Study Tour	I	1,2	2	0	0	0	0	60	40	100	EEC
TOTAL					17	0	8	19	460	540	1000	

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SEMESTER VII												
THEORY												
Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
19ES701	Principles of Management	I, III	9,10,11,12	1	3	0	0	3	40	60	100	ES
19AG701	Bio-Energy Resource Technology	I ,III	1,5,7, 10,11, 12	2	3	0	0	3	40	60	100	PC
	Professional Elective – IV				3	0	0	3	40	60	100	PE
	Professional Elective – V				3	0	0	3	40	60	100	PE
	Open Elective - II				3	0	0	3	40	60	100	OE
PRACTICAL												
19AG702	Project Phase I	I	1,2	3	0	0	4	2	60	40	100	ES
19AG703	Industrial Training (4 weeks)	I	1,2	2	0	0	4	1	60	40	100	EEC
19AG704	Comprehension Review	IV	2,4,9, 10	3	0	0	2	1	100	-	100	EEC
TOTAL					15	0	10	19	420	380	800	

SEMESTER VIII												
THEORY												
Code No	Course	Objective & Outcomes			L	T	P	C	Maximum Marks			Category
		PEOs	POs	PSOs					CA	ES	Total	
	Professional Elective – VI				3	0	0	3	40	60	100	PE
	Professional Elective – VII				3	0	0	3	40	60	100	PE
	Open Elective - III				3	0	0	3	40	60	100	OE
PRACTICAL												
19AG801	Project work	I.II,II	1,2,3, 4,5,6, 7,8,9, 10,11	1,2	0	0	12	6	60	40	100	EEC
TOTAL					6	0	10	15	140	160	300	

TOTAL NO. OF CREDITS: 165

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ELECTIVES

LANGUAGE ELECTIVES								
Code No	Course	Objective & Outcomes			L	T	P	C
		PEOs	POs	PSOs				
19HX201	English for Engineers	I	2,3,6,9,10,12	1	3	0	0	3
19HX202	Hindi	I	2,3,6,9,10,12	1	3	0	0	3
19HX203	Japanese	I	2,3,6,9,10,12	1	3	0	0	3
19HX204	French	I	2,3,6,9,10,12	1	3	0	0	3

PROFESSIONAL ELECTIVE								
SEMESTER V								
ELECTIVE - I								
SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	19AGX01	Systems Analysis and Soft Computing in Agricultural Engineering	PE	3	3	0	0	3
2.	19AGX02	IOT in Agricultural Systems	PE	3	3	0	0	3
3.	19AGX03	Climate change and adoption	PE	3	3	0	0	3
4.	19AGX04	Agricultural Business Management	PE	3	3	0	0	3
5.	19AGX05	Agricultural Economics and Farm Management	PE	3	3	0	0	3
SEMESTER VI								
ELECTIVE - II								
6.	19AGX06	Agricultural Extension	PE	3	3	0	0	3
7.	19AGX07	Remote Sensing and GIS	PE	3	3	0	0	3
8.	19AGX08	Agricultural Waste Management	PE	3	3	0	0	3
9.	19AGX09	Sustainable Agriculture and Food Security	PE	3	3	0	0	3
10.	19AGX10	Ergonomics and Safety in Agricultural Engineering	PE	3	3	0	0	3
ELECTIVE - III								
11.	19AGX11	Protected Cultivation	PE	3	3	0	0	3
12.	19AGX12	Commercial Agriculture Engineering	PE	3	3	0	0	3
13.	19AGX13	Mechanics of Tillage and Traction	PE	3	3	0	0	3
14.	19AGX14	Land Scaping	PE	3	3	0	0	3
15.	19AGX15	Design of Farm Machinery	PE	3	3	0	0	3
SEMESTER VII								
ELECTIVE - IV								
16.	19AGX16	Refrigeration and Air Conditioning for Agricultural	PE	3	3	0	0	3

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		Engineers						
17.	19AGX17	Storage and Packaging Technology	PE	3	3	0	0	3
18.	19AGX18	Seed Processing Technology	PE	3	3	0	0	3
19.	19AGX19	Integrated Farming System Model	PE	3	3	0	0	3
20.	19AGX20	Processing of Spices and Plantation crops	PE	3	3	0	0	3
ELECTIVE – V								
21.	19AGX21	Soil and Water Conservation Engineering	PE	2	3	0	0	3
22.	19AGX22	Testing and Evaluation of Agriculture Machinery	PE	3	3	0	0	3
23.	19AGX23	Special Farm Equipment	PE	3	3	0	0	3
24.	19AGX24	On Farm Water Management	PE	3	3	0	0	3
25.	19AGX25	Fat and Oil Technology	PE	3	3	0	0	3
SEMESTER VIII								
ELECTIVE - VI								
26.	19AGX26	Process Engineering of Fruits and Vegetables	PE	3	3	0	0	3
27.	19AGX27	Watershed Management	PE	3	3	0	0	3
28.	19AGX28	Micro Irrigation	PE	3	3	0	0	3
29.	19AGX29	Post Harvest Technology	PE	3	3	0	0	3
30.	19AGX30	Entrepreneur in Agro Industries	PE	3	3	0	0	3
ELECTIVE - VII								
31.	19AGX31	Energy Auditing and Management	PE	3	3	0	0	3
32.	19AGX32	Automation in Agriculture	PE	3	3	0	0	3
33.	19AGX33	Fundamentals of Nano Science	PE	3	3	0	0	3
34.	19AGX34	Bio and thermo chemical conversion of biomass	PE	3	3	0	0	3
35.	19AGX35	Technologies for precision Agriculture	PE	3	3	0	0	3

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OPEN ELECTIVES								
Code No	Course	Objective & Outcomes			L	T	P	C
		PEOs	POs	PSOs				
OPEN ELECTIVE								
19CEY01	Hazardous Waste Management and Site Remediation	I	1,2,3	1	3	0	0	3
19CEY02	Disaster Mitigation And Management	I	6,7,8	1	3	0	0	3
19CEY03	Environmental Impact Assessment	I	1,2,5,6	1	3	0	0	3
19CEY04	Wealth From Waste	I	1,2,5,6,7	1	3	0	0	3
19CEY05	Product Design and Development			3	3	0	0	3
19CEY06	Supply Chain Management			3	3	0	0	3
19CEY07	Risk And Safety Management	I	1,2,5	1	3	0	0	3
19CEY08	Professional Ethics in Engineering			3	3	0	0	3
19CEY09	Integrated Water Resource Management	I	1,2,4,5,6,7	1	3	0	0	3
19CEY10	Natural Disaster Mitigation And Management	I	1,2,4,	1	3	0	0	3
19CEY11	Energy Conservation and Management			3	3	0	0	3
19CEY12	Fundamentals of Nutrition			3	3	0	0	3
19CEY13	Process Modeling and Simulation			3	3	0	0	3
19CEY14	Natural Resources management			3	3	0	0	3
19CEY15	Labour saving farm machineries			3	3	0	0	3
19CEY16	Organic Farming			3	3	0	0	3

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Department	AGRICULTURE ENGINEERING	R 2019	Semester I	BS

B.E. AGRICULTURE ENGINEERING
(Offered to Other Branches)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AI 1	Integrated Water Resources Management	OE	3	3	0	0	3
2.	AI 2	Environment and Agriculture	OE	3	3	0	0	3
3.	AI 3	Participatory Water Resources Management	OE	3	3	0	0	3
4.	AI 4	Agricultural Finance, Banking and Co-operation	OE	3	3	0	0	3
5.	AI 5	Production Technology of Agricultural machinery	OE	3	3	0	0	3

Summary of Credit Distribution

S.No.	Category	Credits Per Semester								Total Credit	As per AICTE model curriculum
		I	II	III	IV	V	VI	VII	VIII		
1	BS	10	09	04	04					27	26
2	ES	06	09	06		03		05		29	29
3	HS	03	03	02	03					11	12
4	PC			11	18	16	10	03		58	47
5	PE					03	06	06	06	21	23
6	OE						03	03	03	09	11
7	EEC	1	1	0	0	0	0	02	06	10	12
8	MC		00							00	
Total		20	22	23	25	22	19	19	15	165	160

BS- Basic Science **ES**-Engineering Science **HS**-Humanities and Social Science
PE- Professional Elective **OE**- Open Elective **PC**- Professional Core
MC – Mandatory course (Non Credit) **CA**–Continuous Assessment
ES- End semester Examination **EEC**-Employability Enhancement Course

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Department	CIVIL ENGINEERING					R 2019	Semester I	BS
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS101	CALCULUS AND ITS APPLICATIONS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Interpret the introductory concepts of Limit and continuity
- Interpret the introductory concepts of calculus, this will enable them to model and analyze physical phenomena involving continuous change of variables
- Find eigen values and eigen vectors which is one of the powerful tools to handle practical problems arising in the field of engineering.
- Summarize and apply the methodologies involved in solving problems related to functions of several variables.
- Develop enough confidence to identify surface and area there by solving using integration

Course Outcomes: At the end of this course, learners will be able to:

- Apply differentiation to solve maxima and minima problems use both the limit definition and rules of differentiation to differentiate functions
- Identify and model the real time problems using first order linear differential equations. Recognize and solve the higher order ordinary differential equations.
- Analyze the characteristics of a linear system with Eigen values and Eigen vectors.
- Characterize the functions of several variables and get the solutions of the same.
- Integrate the functions for evaluating the surface area and volume.

Unit I	LIMITS AND CONTINUITY	12
Repesentation of a function-Limit of a function-Continuity-Derivatives-Differentiation rules-Maxima and Minima of one variable		
Unit II	**ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Linear differential equations of second and higher order with constant coefficients. Linear differential equations of higher order with variable coefficients: Cauchy's linear differential equation - Method of variation of parameters for second order differential equations-Vibrating string-Electrical circuits		
Unit III	**MULTIVARIABLE CALCULUS**	**12**
Functions of Two Variables - Total Differential - Derivative of implicit functions- Jacobian's- constrained maxima and minima		
Unit IV	**MULTIPLE INTEGRALS**	**12**
. Double integration with constant and variable limits-Region of integration -Change the order of integration -Area as double integral in cartesian coordinates. Triple integral in Cartesian coordinates.		
Unit V	**EIGEN VALUES AND EIGEN VECTORS**	**12**
Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values- Cayley - Hamilton Theorem Orthogonal matrix- Diagonalisation-Quadratic form: Reduction of a quadratic form to a canonical form.		

REFERENCE(S):

1.	Thomas Calculus, 14th Edition by Pearson
2.	Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2015.
3.	Peter V. O Neil , Advanced Engineering Mathematics, Eight Edition , Cengage Learning India Private Limited, 2018
4.	C. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
5.	Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester I	BS
Course Code	Course Name	Hours /Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS102	ENGINEERING PHYSICS	2	0	2	3	60	100	

Course Objective (s): The purpose of learning this course is

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology
- To get the basic knowledge on the properties of matters
- To acquire knowledge in Ultrasonic, Laser and fibers
- To enhance the knowledge in quantum theory
- To understand basic concepts of thermal properties of materials

Course Outcomes: At the end of this course, learners will be able:

- To gain knowledge on the basics of properties of matter and its applications
- To acquire knowledge on the concepts of Ultrasonic and their applications
- To have adequate knowledge on the concepts of fiber & Laser and their applications
- To get knowledge on advanced Physics concepts of quantum theory and its applications in tunneling microscopes and
- To understand knowledge on the concepts of thermal properties of materials and their applications in expansion of joints and heat exchangers

Unit I	PROPERTIES OF MATTER	6

Elasticity – Stress-strain diagram and its uses - torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders.

Unit II	ULTRASONICS	6

Introduction–Classification of Sound- Ultrasonic Production - Magnetostriction generator - Piezo electric generator-cavitations-ultrasonic cleaning-Non Destructive Testing- Pulse echo system through transmission and reflection modes- A, B and C – scan displays- Engineering Applications-Cutting, welding and drilling.

Unit III	LASER AND FIBRE OPTICS	6

Lasers: population of energy levels, Einstein's A and B coefficients derivation – Semiconductor lasers: homojunction and heterojunction – Industrial applications of laser. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – fibre optic sensors: pressure and displacement.

Unit IV	QUANTUM PHYSICS	6

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box.

Unit V	THERMAL PHYSICS	6

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – applications: heat exchangers, ovens and solar water heaters.

REFERENCE(S):

1. Halliday, D., Resnick, R. & Walker, J. —Principles of Physicsǁ. Wiley, 2015
2. Serway, R.A. & Jewett, J.W. —Physics for Scientists and Engineersǁ. Cengage Learning, 2010
3. Tipler, P.A. & Mosca, G. - Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007

List of Experiments

PHYSICS (ANY FIVE 30 Hrs)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. Determination of Young's modulus by uniform bending method
4. Determination of wavelength and particle size using Laser

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	5. Determination of acceptance angle and numerical aperture in an optical fiber 6. Determination of thermal conductivity of a bad conductor – Lee's Disc method 7. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer 8. Determination of wavelength of mercury spectrum – spectrometer grating 9. Determination of band gap of a semiconductor 10. Determination of thickness of a thin wire – Air wedge method

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Department	AGRICULTURE ENGINEERING					R 2019	Semester I	BS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS103	ENGINEERING CHEMISTRY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

1. Understand the basic concepts of water characterization and treatment methods.
2. Know the fundamental concepts of electrochemistry and corrosion.
3. Understand the principles and generation of energy in batteries and nuclear reactors.
4. Gain knowledge on polymers.
5. Know the types of fuels and the manufacture of solid, liquid and gaseous fuels.

Course Outcomes: At the end of this course, learners will be able to:

1. Make the students conversant with water treatment techniques
2. Know the reaction involved in corrosion and corrosion protection methods
3. Impart knowledge on renewable energy sources like nuclear and to impart knowledge on energy storage devices
4. Aware the synthesis & industrial application of polymers
5. Impart knowledge on different types of fuels (solid liquid, gas, primary, secondary and synthetic) and combustion process.

Unit I	WATER CHEMISTRY	9

Hardness of water – types – Estimation of hardness of water by EDTA method– – Domestic water treatment-boiler troubles (scales,sludge,priming,foaming,caustic embrittlememt) – Internal conditioning (carbonate,phosphate, sodium aluminate and calgon) .External treatment – Demineralization process – Reverse Osmosis.

Unit II	ELECTROCHEMISTRY AND CORROSION	9

Electrochemical cell - redox reaction, electrode potential- Nernst equation (derivation and problems). Electro Chemical series-Standard hydrogen electrode-Calomel Electrode. Corrosion: chemical & electrochemical corrosion (galvanic, differential aeration) - types-factors influencing corrosion rate corrosion control - sacrificial anode and impressed current cathodic protection method.

Unit III	ENERGY SOURCES	9

Introduction- nuclear energy- nuclear fission- nuclear fusion- nuclear chain reactions- light water reactor- breeder reactor. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery- lithium ion battery.Fuel cell :H_2 -O_2 fuel cell.

Unit IV	POLYMER CHEMISTRY	9

Monomers - polymers - polymerization - functionality - degree of polymerization - classification of polymers based on source and applications. Types of polymerization: addition, condensation and copolymerization. Preparation, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (poly vinyl chloride, poly tetrafluoroethylene and PMMA). Rubber: SBR. Compounding of plastics (blow moulding, injection, extrusion) .

Unit V	FUELS AND COMBUSTION	9

Fuel: Introduction- classification of fuels- solid fuels-coal- proximate and ultimate analysis- manufacture of metallurgical coke (Otto Hoffmann method) – Liquid fuels: Refining of petroleum- synthetic petrol Fischer-Trophs and Bergius processes- knocking- octane number- cetane number – Gaseous fuels: liquefied petroleum gases(LPG)- water gas- bio diesel. Combustion- flue gas analysis (ORSAT Method).

TEXT BOOK(S):

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2019

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2.	Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2019
REFERENCE(S):	
1.	Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2016
2	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2017.
3.	GowarikerV.R,Viswanatha. N.V,Jayadev Sreedhar- "Polymer Science", Publishing company New Age International Publishers, New Delhi,2015.
4.	Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2017.
5	AshimaSrivastava and Janhavi N N., "Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2015.

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Department	CIVIL ENGINEERING					R 2019	Semester I	BS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS101	COMMUNICATIVE ENGLISH	3	0	0	3	45	100	

Course Objective (s):

- To acquire basic English grammar.
- To develop listening skills to listen lectures and basic videos.
- To enhance the reading skill to comprehend technical writings.
- To improve writing skills to express thoughts freely.
- To develop speaking skills to speak fluently in real contexts.

Course Outcomes: At the end of this course, learners will be able to:

- Improve language usage in LSRW skills.
- Develop listening skills to comprehend general / technical talks.
- Acquire the ability to understand different written texts.
- Enhance the writing skills to express the ideas of the learners.
- Communicate fluently in real time context.

Unit I	LANGUAGE FOCUS	9

Parts of speech - Word formation - Sentence types (declarative, imperative, exclamatory & interrogative) - Tense forms - Subject - Verb agreement

Unit II	LISTENING	9

Listening for specific information: Short conversations / monologues - Gap filling - Telephone conversations - Telephone etiquette - Note-taking - Listening for gist / interviews - Listening to songs and completing the lyrics - Clear individual sounds - Word stress

Unit III	READING	9

Completing the sentences - Prediction - Skimming for gist - Scanning for specific information - Understanding text and sentence structure - Close reading

Unit IV	WRITING	9

Paragraph writing (descriptive, narrative, expository & persuasive) - Letter (formal and informal) - Dialogue writing - E-mail - Instructions

Unit V	SPEAKING	9

Self-introduction - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Mini-presentation - Expressing opinions and justifying opinions - Agreement / disagreement - Likes and dislikes

TEXT BOOK(S):

1. Communicative English by KN Shoba , Lourdes Joavani Rayen Published by Cambridge university 2017.

REFERENCE(S):

1. Murphy, Raymond. English Grammar in Use – A Self-Study Reference and Practice Book For Intermedi learners Of English .Ived. United Kingdom: Cambridge University Press. 2012.
2. **Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxfor University Press. 2005.**
3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press 1992.
4. Wren and Martin, High school English Grammar and Composition, Publisher: S.Chand. 2019.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester I	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES102	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	2	0	2	3	60	100	

Course Objective (s): The purpose of learning this course is

- Understand the basic concepts of electric circuits and magnetic circuits.
- Illustrate the construction and operation of various electrical machines and semiconductor devices.
- Learn the fundamentals of communication systems.

Course Outcomes: At the end of this course, learners will be able

- Apply the fundamental laws to electric circuits and compute the different alternating quantities
- Apply the laws of magnetism for the operation of DC motor.
- Examine the construction and working principle of different AC machines.
- Analyze the different speed control methods of DC motors and special machines
- Analyze the performance characteristics and application of semi-conductor devices

Unit I	ELECTRIC CIRCUITS	6

Definition of Voltage, Current, Electromotive force, Resistance, Power & Energy, Ohms law and Kirchoffs Law & its applications - Series and Parallel circuits - Voltage division and Current division techniques - Generation of alternating emf - RMS value, average value, peak factor and form factor- Definition of real, reactive and apparent power.

Unit II	DC MACHINES	6

Introduction of magnetic circuits-Law of electromagnetic induction, Fleming's Right and Left hand rule-types of induced EMF-Definitions of self and mutual inductance-DC Motor- Construction - Working Principle –Applications.

Unit III	AC MACHINES	6

Single Phase Transformer - Alternator - Three phase induction motor - Single phase induction motor - Construction - Working Principle -Applications.

Unit IV	ELECTRICAL DRIVES	6

Speed control of DC shunt motor and series motor-Armature voltage control-Flux control-Construction and operation of DC servo motor and stepper motor-

Unit V	ELECTRONIC DEVICES AND COMMUNICATION	6

Characteristics of PN Junction Diode and Zener Diode - Half wave and Full wave Rectifiers – Bipolar Junction Transistor – Operation of NPN and PNP transistors – Logic gates-Introduction to Communication Systems

TEXTBOOKS(S):

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd.,2010

REFERENCE(S):

1. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010

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SL.NO	LIST OF EXPERIMENTS	
1.	Load test on DC Shunt motor	
2.	Load test on DC Series motor	
3.	Load test on single phase transformer	
4.	Speed control of DC shunt motor	
5.	Load test on single phase Induction Motor.	
6.	VI characteristics of Diodes	
7.	Half and full wave rectifier with and without filter-observe the waveform using CRO	
SL.NO	**NAME OF EQUIPMENT**	**NO OF QUANTITY**
1.	DC Shunt motor	2
2.	DC Series motor	1
3.	Single phase transformer	2
4.	Single phase Induction motor	1
5.	Ammeter AC & DC	20
6	Voltmeter AC & DC	20
7.	Wattmeter LPF & UPF	4
8	Dual regulated Power Supply	4
9	CRO	4
10	AC Signal generator	4
11	Diode	As required

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Department	AGRICULTURE ENGINEERING					R 2019	Semester I	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES106	ENGINEERING GRAPHICS	0	0	4	2	60	100	

Course Objective(s): The purpose of learning this course is:

- To learn conventions and use of drawing tools in making engineering drawings.
- To draw orthographic projection of points and lines.
- To draw the projection of planes and simple solids.
- To draw the section of solids and obtain the development of surfaces of given solids.
- To draw the isometric projection of the given solids.

Course Outcome(s): At the end of this course, learners will be able to:

- Recognize the conventions and apply construct basic engineering curves.
- Draw the orthographic projection of points and lines.
- Draw the projection of planes and simple solids.
- Draw the section of solid drawings and development of surfaces of given solids.
- Draw the isometric projection of the given objects.

CONCEPTS AND CONVENTIONS (Not for Examination)	01

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

Unit I	PLANE CURVES	12

Basic Geometrical constructions, Curves used in engineering practice: Conics – Construction of ellipse, parabola and hyperbola by Eccentricity method – Construction of Cycloid – construction of Involutes of triangle, square and circle – Drawing of tangents and normal to the above curves.

Unit II	PROJECTION OF POINTS AND LINES	09

Orthographic projection – principles - Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projection) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

Unit III	PROJECTION OF PLANES & SOLIDS	14

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes. Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by Rotating Object method.

Unit IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – prisms, pyramids, cylinders and cones.

Unit V	ISOMETRIC VIEW / PROJECTION & PERSPECTIVE PROJECTION	12

Principles of Isometric view – isometric scale – Isometric projections of simple solids - Prisms, pyramids, cylinders, cones - combination of two solid objects in simple vertical positions. Introduction to Perspective projection.

TEXT BOOK(S):

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

REFERENCE(S):

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1.	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2.	Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3.	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4.	N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5.	Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester I	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES107	WORKSHOP PRACTICES	0	0	2	1	30	100	

Course Objective(s): The purpose of learning this course is:

- To provide hands-on training in fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To acquire the skill for making fitting joints and household pipe line connections using suitable tools.
- To develop the skill for preparing the green sand mould.
- To provide hands-on training in assembling and dismantling of petrol engines, gear boxes and pumps.
- To develop the skill for making wood/sheet metal models using suitable tools.

Course Outcome(s): At the end of this course, learners will be able to:

- Fabricate simple components using carpentry, sheet metal and welding equipment/tools.
- Make fitting joints and household pipe line connections using suitable tools.
- Prepare green sand mould.
- Assemble and dismantle petrol engines, gear boxes and pumps.
- Make simple models using wood and sheet metal.

Exp. No	Name of the Experiments
1	Forming of simple object in sheet metal using suitable tools (Example: Dust bin / Tray)
2	Fabrication of a simple component using thin and thick plates. (Example: Book rack)
3	Hands-on-exercise: Wood work, joints by sawing, planning and cutting.
4	Making a simple component using carpentry power tools. (Example: Pen stand/Tool box/Letter box)
5	Prepare a "V", Half-round or Square joint from the given mild steel flat plate.
6	Construct a household pipe line connections using pipes, Tee-joint, Four-way joint, elbow, union, bend, gateway and taps (or) Construct a pipe connection for domestic application (centrifugal pump) using pipes, bend, gate valve, flanges and foot valve.
7	Prepare a green sand mould using solid pattern/split pattern.
8	Dismantling and assembly of two-stroke and four-stroke petrol engine.
9	a) Preparation of butt joints, lap joints and T- joints by Electric Arc Welding. b) Gas Welding practice.
10	Mini-Project (Fabrication of small components).

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	QUANTITY
1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings	15 sets
2	Carpentry Vice (fitted to work bench)	15 Nos.
3	Standard wood working tools	15 Sets.
4	Models of industrial trusses, door joints, furniture joints	5 each
5	Power Tools: (a) Rotary Hammer	2 Nos.
	(b) Circular Saw	2 Nos.
	(c) Planer	2 Nos.
	(d) Hand Drilling Machine	2 Nos.
	(e) Jigsaw	2 Nos.
6	Arc welding transformer with cables and holders	5 Nos.
7	Welding booth with exhaust facility	2 Nos.
8	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
9	Oxygen and acetylene gas cylinders, blow pipe and other welding outfits	2 Nos.
10	File Sets	2 Nos.
11	Hearth furnace, anvil and smithy tools	2 Sets.
12	Moulding table, foundry tools	2 Sets.

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13	Power Tool: Angle Grinder	2 Nos.
14	Study-purpose items: Centrifugal pump, Air-conditioner	One each.
15	2S & 4S IC Engines	One each.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester I	EEC
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS01	SOFT SKILLS - I	1	0	1	1.5	30	100	

Course Objective (s): The purpose of learning this course is

- To develop basic grammar knowledge in English.
- To enhance Speaking Skills in English
- To improve Verbal and Non-verbal Communication Skills
- To develop Confidence and Emotional Intelligence
- To develop Inter Personal Skills.

Course Outcomes: At the end of this course, learners will be able to:

- Have competent knowledge of grammar
- Speak fluent English by enriching Vocabulary Knowledge.
- Have good Presentation Skills through verbal and non verbal communication.
- Handle any Situation with confidence by being emotionally stable.
- Work in a team by having team coherence and dealing with people.

UNIT 1	Effective English – Written English	6

Basic rules of Grammar - Parts of Speech – Tenses – Verbs.Sentence Construction.Dialogues and Conversations – Writing. Exercises to practice and improve these skills.

UNIT 2	Effective English – Spoken English	6

Vocabulary – Idioms & Phrases – Synonyms – Antonyms.Dialogues and Conversations –Writing. Exercises to practice and improve these skills.

UNIT 3	Art of Communication & The Hidden Data Involved	6

Verbal Communication - Effective Communication - Active listening –Paraphrasing – Feedback.
Non Verbal Communication - Body Language of self and others.
Importance of feelings in communication - dealing with feelings in communication.

UNIT 4	World of Teams – Part -01	6

Self Enhancement - importance of developing assertive skills- developing self confidence – developing emotional intelligence.

UNIT 5	World of Teams – Part -02	6

Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved Working with Groups – Dealing with People- Group Decision Making.

TOTAL : 30(15 Theory + 15 Practical) Hours

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Department	CIVIL ENGINEERING					R 2019	Semester II	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES214	CAD FOR AGRICULTURAL ENGINEERS	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- To impart training to draw orthographic views of machine components using CAD Modelling Software
- To develop the skill to create three dimensional models from orthographic views using CAD Modelling Software
- To create three dimensional assembly models and their animation using standard CAD packages

Course Outcomes: At the end of this course, learners will be able to

- Draw two dimensional drawings of engineering components using standard CAD Modelling package
- Develop a three dimensional assembly model consisting of many components with tolerances.
- Generate animations from three dimensional assembly models by applying various motion constraints

List of Experiments

1.	Introduction to modeling software: Practicing sketching, Dimensioning and Modelling Tools and Creating simple 3D models by using any CAD Modelling Software
2.	Create a orthographic views of machine components from isometric component drawing
3.	Create a two dimensional sketch diagrams of simple machine components
4.	Create a three dimensional assembly model of bearing from detailed orthographic drawings
5.	Create a three dimensional assembly model of bearing from detailed orthographic drawings
6.	Create a three dimensional assembly model of I C Engine components from detailed orthographic drawings
7.	Create a three dimensional assembly model of gear box from detailed orthographic drawings
8.	Create a three dimensional assembly model of two wheeler suspension system from detailed orthographic drawings
9.	Create a three dimensional assembly model of valves from detailed orthographic drawings
10.	Create a three dimensional assembly model of simple mechanism and animate its working in modeling software
11.	Create a three dimensional assembly model of simple energy conversion/power transmission system and animate its working using modeling software

REFERENCE(S):

1.	Donnie Gladfelter, Autocadd 2013 and Autocadd LT 2013, Autodesk official training guides, 2013
2.	Ellen Finkelstein, Autocadd 2012 and Autocadd LT 2012 Bible, 2012.

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REFERENCES:

1. The Seven Habits of Highly Effective People - Stephen R. Covey.
2. All the books in the "Chicken Soup for the Soul" series.
3. Man's search for meaning – Viktor Frankl
4. The greatest miracle in the world – Og Mandino
5. Goal - Eliyahu Goldratt.
6. Working with Emotional Intelligence - David Goleman.
7. Excel in English – Sundra Samuel, Samuel Publications
8. Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi
9. Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
10. Effective Presentation Skills (A Fifty-Minute Series Book) by Steve Mandel
11. "Strategic interviewing" by Richaurd Camp, Mary E. Vielhaber and Jack L. Simonetti – Published by Wiley India Pvt. Ltd
12. "Effective Group Discussion: Theory and Practice" by Gloria J. Galanes, Katherine Adams , John K. Brilhart

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Department	AGRICULTURE ENGINEERING					R 2019	Semester II	BS
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS201	VECTOR CALCULUS AND COMPLEX VARIABLES	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Calculus viz: Vector, Vector Differentiation and Vector Integration.
- Implement the Complex Analysis, an elegant method in the study of heat flow, fluid dynamics and electrostatics.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.
- Defining a complex function and solving through complex integration

Course Outcomes: At the end of this course, learners will be able to:

- Characterize the calculus of vectors.
- Apply the theoretical aspects of vector integral calculus in their core areas.
- Recognize the differentiation properties of complex functions.
- Identify the complex functions and their mapping in certain complex planes.
- Use the concepts of integration to complex functions in certain regions.

Unit I	DIFFERENTIATION OF VECTORS	12

Vector point function- Directional derivative - Gradient -Divergence -Curl - Solenoidal – Irrotational vector fields –Scalar potential

Unit II	INTEGRATION OF VECTORS	12

Work done - Line Integral - Surface integral- Green's theorem in a plane- Stoke's Theorem- Gauss divergence theorem- Applications involving cubes and parallelepiped.

Unit III	ANALYTIC FUNCTIONS	12

Analytic Functions- Necessary and Sufficient conditions of Analytic Function- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method -Applications to the problems of Potential Flow.

Unit IV	MAPPING OF COMPLEX FUNCTIONS	12

Conformal mapping- Application of transformation: translation, rotation, magnification and inversion of multi valued functions - Linear fractional Transformation (Bilinear transformation).

Unit V	COMPLEX INTEGRATION	12

Cauchy's Fundamental Theorem - Cauchy's Integral Formula - Taylor's and Laurent's series- Classification of Singularities - Cauchy's Residue Theorem

REFERENCE(S):

1	Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015
2	C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-HillPublishing Company Ltd, 2003
3	J. A. Brown and R. V. Churchill, Complex Variables and Applications , Sixth Edition, McGraw Hill,New Delhi, 1996
4	Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition ,Cengage Learning India Private Limited, 2012
5	Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India,2007

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Department	AGRICULTURE ENGINEERING					R 2019	Semester	II
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS209	APPLICATION OF PHYSICS TO AGRICULTURE ENGINEERS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is

- To make the students learn various physical properties of soil and methods for analyzing the properties of soil
- To make the students understand the detailed mechanism of photosynthesis in leaves
- To introduce the students about various biophysical methods employed in the field of agriculture
- To instill knowledge on the fundamentals of electromagnetic radiation and remote sensing
- To familiarize the students about preservation and processing of food with ionizing radiation

Course Outcomes: At the end of this course, learners will:

- learn about physical properties of the soil and methods for analyzing the physical properties.
- understand the structure of the leaves and mechanism of photosynthesis in leaves
- acquire knowledge about various biophysical methods employed in the field of agriculture
- gain knowledge on the fundamentals of electromagnetic radiation and use of remote sensing in agriculture and irrigation
- familiarize with effects of ionizing radiation on foods, and processing of seeds, spices, fruits and vegetables

Unit I	SOIL PHYSICS	9

Soil as a dispersion three-phase system - Volume and mass relationships of soil constituents - solid phase - liquid phase - gaseous phase - soil heat flow - soil compaction and consolidation - The Field soil water regime - Solute transport in soil - Methods for analyzing spatial variations of soil properties

Unit II	PHOTOSYNTHESIS	9

Photosynthesis - Leaves and leaf structure - The nature of light - Chlorophyll and accessory pigments - The structure of the chloroplast and photosynthetic membranes - Stages of photosynthesis - The light reactions - Dark reaction - C-4 Pathway - The carbon cycle

Unit III	BIOPHYSICS	9

Biophysics - Biophysics methods applicable in agriculture - possibilities of application of new methods in agriculture - effects in agriculture with biophysical methods - effects of new methods applied in agriculture in protection of environment - X-ray separation of crops - electrostatic - Spraying of crops - Moisture determination in agricultural materials

Unit IV	REMOTE SENSING IN AGRICULTURE AND IRRIGATION	9

Electromagnetic spectrum: The photon and radiometric quantities - radiant energy - radiant flux density - radiant intensity - transmittance - absorptance - reflectance - distribution of radiant energies - spectral signatures - sensor technology - sensor types - passive and active - spatial resolution - processing and classification of remote sensed data - pattern recognition - approaches to data / image interpretation - use of remote sensing in agriculture and irrigation

Unit V	FOOD IRRADIATION AND PRESERVATION	9

Effects of ionizing radiation on biological organism - Effects of ionizing radiation on foods - applications of food irradiation - low dose - medium dose and high dose - Food irradiation using electron beams, X-rays -

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nuclear radiation - Processing of seeds, spices, fruits and vegetables
TEXT BOOK(S): 1. Koorevaar P., Menelik, G. and Dirksen, C., "Elements of Soil Physics", Elsevier Science & Technology (1999) 2. Miller R.B., "Electronic radiation of foods: An Introduction to Technology", Springer (2005). 3. George Joseph, "Fundamentals of Remote Sensing", University Press Pvt.Ltd. (2005).
REFERENCE(S): 1. H.Don Scott, "Soil Physics: Agriculture and Environmental Applications". Wiley (2000). 2. Manoj Shukla, "Soil Physics: An Introduction", CRC Press (2013). 3. Lawlor D.W. "Photosynthesis", Bioscientific Publishersw Ltd. (2001). 4. Aymn Elhaddad, "Remote Sensing Applications in Agriculture", Vom Verlag (2009).

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TEXT BOOK(S):

1. Koorevaar P., Menelik, G. and Dirksen, C., "Elements of Soil Physics", Elsevier Science & Technology (1999).
2. Miller R.B., "Electronic radiation of foods: An Introduction to Technology", Springer (2005).
3. George Joseph, "Fundamentals of Remote Sensing", University Press Pvt.Ltd. (2005).

REFERENCE(S):

1. H.Don Scott, "Soil Physics: Agriculture and Environmental Applications". Wiley (2000).
2. Manoj Shukla, "Soil Physics: An Introduction", CRC Press (2013).
3. Lawlor D.W. "Photosynthesis", Bioscientific Publishersw Ltd. (2001).
4. Aymn Elhaddad, "Remote Sensing Applications in Agriculture", Vom Verlag (2009).

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Department	AGRICULTURE ENGINEERING					R 2019	Semester II	MC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19MC201	ENVIRONMENTAL SCIENCE AND ENGINEERING	3	0	0	0	45	100	

Course Objective (s): The purpose of learning this course is to

1. Study the nature and facts about environment.
2. Finding and implementing scientific, technological and economic solutions to environmental problems.
3. Know the types of natural resources and the individual role in conserving the resources.
4. Apply the knowledge to various social issues by understanding the environmental legislation laws.
5. Study the integrated themes and biodiversity, natural resources, pollution control and waste management.

Course Outcomes: At the end of this course, learners will be able to:

1. Extend their knowledge in maintaining ecological balance and make use of their knowledge in the preservation of biodiversity.
2. Outline the role of human being in maintaining a clean environment and useful environment for the future generations.
3. Explain the constituents of environment, precious resources in the environment and conservation of natural resources.
4. Find the role of government and Non-Government organization and explain the various rain water harvesting techniques.
5. Develop their awareness about population growth, Family planning programme and HIV/AIDS and extend their knowledge in role of information technology in environment & human health.

Unit I	ECOSYSTEMS AND BIODIVERSITY	10

Environment: Scope – importance - need for public awareness -Concepts of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Food chains- food webs - types of ecosystem - structure and functions of forest ecosystem and river ecosystem – Biodiversity - value of biodiversity - consumptive use-productive use - social - ethical - aesthetic values - Hotspots of biodiversity - Threats to biodiversity - Habitat loss - poaching of wildlife and man wildlife conflicts. Conservation of biodiversity - In-situ and Ex-situ conservation.

Unit II	ENVIRONMENTAL POLLUTION	8

Pollution: Causes - effects and control measures of Air pollution - Water pollution - Soil pollution and Noise pollution - Solid waste management - Causes - effects -control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster managements - Floods - cyclone- landslides.

Unit III	NATURAL RESOURCES	9

Forest resource - Use-over exploitation -deforestation - Water resource - use-over utilization of surface and ground water - conflicts over water - Mineral resource - use-exploitation-environmental effects of extracting and using mineral resource - Food resources - world food problems changes caused by agriculture - Effects of modern agriculture - fertilizer- pesticide problems - Energy resource - Renewable energy sources - solar energy - wind energy. Land resources - land degradation - soil erosion - Role of an individual in conservation of natural resources.

Unit IV	SOCIAL ISSUES AND THE ENVIRONMENT	9

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Sustainable & Unsustainable development-Water conservation - rain water harvesting (roof top method)-climate change-global warming - acid rain - ozone layer depletion - Environment protection act - Air (Prevention and control of pollution) Act - Water (prevention and control of pollution) Act - Green Chemistry – 12 Principles of Green chemistry – Application of Green chemistry.		
Unit V	**HUMAN POPULATION AND THE ENVIRONMENT**	**9**
Population growth - variation among nations - Population explosion & its consequences – Family, child, women welfare programmes - Human rights - HIV/AIDS – Human health and environment - Role of information technology in environment and human health.		

TEXT BOOK(S):

1.	Anubha Kaushik and C.P. Kaushik, Environmental Science and Engineering, New Age International Publishers, New Delhi (2015)
2.	Dr. A.Ravikrishan, Environmental Science and Engineering., Sri Krishna Hitech Publishing co. Pvt. Ltd., Chennai,12th Edition (2016)

REFERENCE(S):

1.	Masters, Gilbert M, —Introduction to Environmental Engineering and Sciencell, Second Edition, Pearson Education, New Delhi (2012).
2.	Santosh Kumar Garg, Rajeshwari garg, smf Ranjni Garg —Ecological and Environmental Studiesll Khanna Publishers, Nai Sarak, Delhi (2014).
3.	R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard", Vol. I and II, Enviro Media.
4.	Dharmendra S. Sengar, "Environmental law", Prentice Hall of India PVT LTD, New Delhi, 2007. 4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press 2005
5.	Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2015.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester II	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES201	PROBLEM SOLVING AND PYTHON PROGRAMMING	3	0	0	3	45	100	

Course Objective (s):

The purpose of learning this course is

- To understand problem solving techniques .
- To understand why Python is a useful scripting language for developers and to read and write simple Python programs.
- To develop Python programs with conditionals and loops
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python

Course Outcomes:

At the end of this course, learners will be able to

- Apply problems solving techniques to real world problems.
- Recognize and construct common programming idioms: variables, loop, branch, and input/output.
- Be able to design, code, and test Python programs using List, Tuples and Strings
- Able to write code using dictionaries and functions
- Able to read and write data from/to files in Python Programs.

Unit I	PROBLEM SOLVING TECHNIQUES	9

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems, Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming

Unit II	INTRODUCTION TO PYTHON	6

History- Installation and Working with Python- Understanding Python variables - Python basic Operators - Declaring and using Numeric data types: int, float, complex-Using string data type and string operations- Methods

Unit III	FLOW CONTROL, LIST AND TUPLES	12

Conditional blocks using if, else and elif - Simple for loops in python - For loop using ranges- Use of while loops in python - Loop manipulation using pass, continue, break and else- Programming using Python conditional and loops block Creating List - Accessing list - Operations on List - Working with lists - Function and Methods – Creating tuple - Tuple Operations – Functions and Methods

Unit IV	DICTIONARIES ,FUNCTIONS AND MODULES	9

Creating Dictionaries - Accessing values in dictionaries - Working with dictionaries - Properties – Functions - Defining a function - Calling a function - Types of functions - Function Arguments - Anonymous functions - Global and local variables - Modules - Importing module - Math module - Random module - Packages - Composition.

Unit V	FILES AND EXCEPTION HANDLING	9

Files - Opening and closing file- File Opening Modes - Reading and writing files - Functions. Exception Handling - Exception - Exception Handling - Except clause - Try , finally clause User Defined Exceptions

TEXT BOOK(S)

1. David Riley and Kenny Hunt, "Computational Thinking for the Modern Problem Solver", Chapman & Hall/CRC, 2014.
2. M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011.

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REFERENCE(S)	
1.	Brian Heinold, "Introduction to Programming Using Python", Mount St. Mary's University, 2013.
2.	Michael Dawson ,"Python Programming for the Absolute Beginner" , 3rd Edition, 2010.
3.	Allen Downey, Green Tea Press Needham, "Think Python, How to Think Like a Computer Scientist", Massachusetts.
4.	Cunningham, sams teach yourself python in 24 hours, Second edition Pearson, 2014

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Department	AGRICULTURE ENGINEERING					R 2019	Semester II	HS
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HX201	ENGLISH FOR ENGINEERS	3	0	0	3	45	100	

Course Objective (s):

- To acquire the usage of grammar in English language.
- To develop listening skills which will enable to listen lectures and comprehend different types of texts.
- To enhance the reading skill to comprehend technical writings.
- To improve writing skills to express thoughts freely.
- To develop speaking skills to speak fluently in real contexts.

Course Outcomes: At the end of this course, learners will be able to:

- Improve their language usage in LSRW skills.
- Develop listening skills to understand sentence stress and intonations.
- Acquire the ability to understand different written texts.
- Enhance the writing skills to express the ideas of the learners.
- Communicate fluently in pair / team.

Unit I	LANGUAGE FOCUS	9

Voice(Active & Passive) - Reported speech - Conditionals - Collocations - Discourse markers - One word substitution - Phrasal verbs - Error identification

Unit II	LISTENING	9

Listening for specific information – Identifying sentence stress - Rhythm - Intonation

Unit III	READING	9

Reading graphs and charts - Skimming and scanning texts – Identifying topic sentences - Understanding the structure of a text

Unit IV	WRITING	9

Job Application, Letter and Resume - Recommendations - Report writing (accident and survey) - Writing review (book and movie) - Transcoding (interpreting charts & diagrams)

Unit V	SPEAKING	9

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging - Language Functions: suggesting - comparing and contrasting -Expressing - finding out facts, attitudes and opinions

TEXT BOOK(S):

1. Communicative English by KN Shoba ,Lourdes Joavani Rayen Published by Cambridge university Revised Edition 2018

REFERENCE(S):

1. Jeremy Comfort, Pamela Rogerson, Trish Stott, and Derek Utley, Speaking Effectively and Developing Speaking Skills for Business English, Cambridge: Cambridge University Press, 2002.
2. Eric H. Glendinning and Beverly Holmstrom, Study Reading: A Course In Reading for Academic Purposes. United Kingdom: Cambridge University Press, 2004.
3. Murphy, Raymond. English Grammar in Use – A Self-Study Reference and Practice Book For Intermed learners Of English .Ived. United Kingdom: Cambridge University Press. 2012.
4. Seely, John. Oxford Guide to Effective Writing and Speaking. Indian ed. New Delhi: Oxford University Press. 2005.

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Department	AGRICULTURE ENGINEERING					R 2019	Semesterll	ES
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES209	MECHANICS FOR ENGINEERS	3	1	0	4	60	100	

Course Objectives: The purpose of learning this course is to:

- Familiarize basic concepts and force systems in real-world environment.
- Provide knowledge on statics of particles in space with moment & equilibrium of rigid bodies.
- Study the moment of inertia of surfaces and solids.
- Determine the solution for the problems related to kinematics of particles and forces associated with work, energy, impulse and momentum.
- Learn the concepts of static friction & geometric motion of rigid bodies.

Course Outcomes: At the end of this course, learners will be able to:

- Illustrate the vectorial and scalar representation of forces and moments.
- Analyze the rigid body in equilibrium.
- Evaluate the properties of surfaces and solids.
- Calculate dynamic forces exerted in rigid body.
- Determine the friction and the effects by the laws of friction.

Unit I	STATICS OF PARTICLES	12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.

Unit II	EQUILIBRIUM OF RIGID BODIES	12

Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force - Equilibrium of Rigid bodies in two dimensions.

Unit III	PROPERTIES OF SURFACES AND SOLIDS	12

Centroids and centre of mass – Centroids of areas - Rectangular, circular, triangular areas by integration – T- section, I-section, Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia of prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

Unit IV	DYNAMICS OF PARTICLES	12

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work-Energy Equation– Impulse and Momentum – Impact of elastic bodies.

Unit V	FRICTION AND RIGID BODY DYNAMICS	12

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TEXT BOOK(S)

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCE(S)

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1.	Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2.	Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3.	Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
4.	Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5.	Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester II	BS
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES213	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	0	0	2	1	30	100	

Course Objective (s):

The purpose of learning this course is

- To apply problem solving techniques
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

Course Outcomes:

At the end of this course, learners will be able to

- To write algorithm, pseudo code and draw flowchart
- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

List of Experiments

- Write algorithms and pseudo code to solve real time problems
- Draw flow Chart
- Working in Python Interpreter
- Simple python programming using looping and conditional statements
- Programs to handle strings
- Programs using list, tuples and dictionaries
- Programs using functions
- Programs using modules and packages
- Program to handle files and exception handling
- Program to draw various charts

Platforms needed : Python 3 interpreter for Windows / Linux

TEXT BOOK(S)

1, David Riley and Kenny Hunt, "Computational Thinking for the Modern Problem Solver", Chapman & Hall/CRC, 2014.

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2,	M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011.
REFERENCE(S)	
1.	Brian Heinold, "Introduction to Programming Using Python",Mount St. Mary's University, 2013.
2.	Michael Dawson ,"Python Programming for the Absolute Beginner" , 3rd Edition, 2010.
3.	Allen Downey, Green Tea Press Needham, "Think Python, How to Think Like a Computer Scientist", Massachusetts.
4.	Cunningham, sams teach yourself python in 24 hours, Second edition Pearson, 2014.

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Department	Common to all Branches					R 2019	Semester II	EEC
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19TPS02	SOFT SKILLS - II	1	0	1	1.5	30	100	

Course Objective (s): The purpose of learning this course is

- To train the Students on Group Discussion Do's and Don'ts.
- To coach the students on Interview Skills.
- To develop Presentation Skills.
- To develop Business Etiquette.
- To teach importance of Ethics and Values.

Course Outcomes: At the end of this course, learners will be able to:

- Participate Group Discussion with Confidence by knowing the tips and Tricks.
- Attend the interview with positive attitude by having Mock Interviews.
- Present them very well by enhancing their Presentation Skills.
- Behave very well in official gathering and Meeting by knowing Etiquette.
- Have good ethics and values in their Personal and Professional Life.

UNIT 1	GROUP DISCUSSION	6

GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback.

UNIT 2	INTERVIEW SKILLS	6

Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback.

UNIT 3	PRESENTATION SKILLS	6

Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback.

UNIT 4	Business Etiquette	6

Grooming etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress.

UNIT 5	Ethics	6

Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.

TOTAL : 30 (15 Theory +15 Practical) Hours

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REFERENCES:

1. The Seven Habits of Highly Effective People - Stephen R. Covey.
2. All the books in the "Chicken Soup for the Soul" series.
3. Man's search for meaning – Viktor Frankl
4. The greatest miracle in the world – Og Mandino
5. Goal - Eliyahu Goldratt.
6. Working with Emotional Intelligence - David Goleman.
7. Excel in English – Sundra Samuel, Samuel Publications
8. Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi
9. Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
10. Effective Presentation Skills (A Fifty-Minute Series Book) by Steve Mandel
11. "Strategic interviewing" by Richaurd Camp, Mary E. Vielhaber and Jack L. Simonetti – Published by Wiley India Pvt. Ltd
12. "Effective Group Discussion: Theory and Practice" by Gloria J. Galanes, Katherine Adams , John K. Brilhart

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Department	AGRICULTURE ENGINEERING					R 2019	Semester	II
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
19BS208	ENGINEERING CHEMISTRY LAB	L	T	P	C	60	100	
		0	0	4	2			

Course Objective (s): The purpose of learning this course is to

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of chloride content of water sample by Argentometric method.
3. Estimation of iron content of the given solution using potentiometer.
4. Determination of strength of given hydrochloric acid using pH meter
5. Conductometric titration of strong acid vs strong base.

Course Outcomes: At the end of this course, learners will be able to

1. Make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis.
2. Acquire the knowledge about chloride content in water sample.
3. Make the student to acquire practical skills about strength of iron using potentiometric titrations.
4. Understand the how to estimate hydrochloric acid in water sample using pH meter.
5. Gain the knowledge about conductance of ions.

Exp No.	Name of Experiments (Any Ten)
1	Determination of Total, Temporary & Permanent hardness of water by EDTA method.
2	Determination of chloride content of water sample by Argentometric method.
3	Determination of Dissolved oxygen content in water sample using Winklers Method
4	Determination of Alkalinity in Water Sample
5	Determination of strength of given hydrochloric acid using pH meter.
6	Determination of strength of acids in a mixture of acids using conductivity meter.
7	Conductometric titration of Weak acid vs Weak base.
8	Estimation of iron content of the given solution using potentiometer.
9	Conductometric titration of strong acid vs strong base.
10	Determination of Molecular weight of polyvinyl alcohol using Ostwald viscometer
11	Estimation of iron content of the water sample using spectrophotometer
12	Estimation of Copper in Brass

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Department	AGRICULTURE ENGINEERING					R 2019	Semester III	BS
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS303	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- To understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- To implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- To summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation
- To develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Course Outcomes: At the end of this course, learners will be able to:

- Recognize the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.
- Formulate a function in frequency domain whenever the function is defined in time domain.
- Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
- Classify a partial differential equation and able to solve them.
- Apply and solve the engineering problems in the area of heat, wave equations.

Unit I	FOURIER SERIES	12

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value

Unit II	LAPLACE TRANSFORM	12

Laplace Transform- Existence Condition -Transforms of Standard Functions - Unit step function, Unit impulse function- Properties- Transforms of Derivatives and Integrals - Initial and Final Value Theorems - Laplace transform of Periodic Functions - Inverse Laplace transforms.

Unit III	FOURIER TRANSFORM	12

Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity

Unit IV	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous types

Unit V	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	12

Classification of Second Order Quasi Linear Partial Differential Equations - Fourier Series Solutions of One Dimensional Wave Equation - One Dimensional Heat Equation - Steady State Solution of Two-Dimensional Heat Equation - Fourier Series Solutions in Cartesian Coordinates

REFERENCE(S):

1. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, Inc,

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	Singapore, 2008.
3.	Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition, Cenage Learning India Private Ltd, 2012.

Department	AGRICULTURE ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19CE301	MECHANICS OF SOLIDS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Develop the understanding on the state of stresses and strains in engineering components as a result of different loading conditions
- Provide the principles and equations, and necessary tools to analyze structural members under axial loads, bending, shear, and torsion.

Course Outcomes: At the end of this course, learners will be able to:

- Determine the stresses and strains in the members subjected to axial loads
- Determine the principal stresses and strains in structural members
- Determine the stresses and strains in the members subjected to loads in various types of beams
- Determine the bending stress and strain energy due to bending moment.
- Determine the stresses in shaft due to torsion loads.

Unit I	STRESSES AND STRAINS	10

Stress at a point - Types of stress - Strain at a point - Types of strain - Elastic limit - Hooke's law - Modulus of elasticity - Stress-Strain diagram - Stresses in composite bars - Thermal stresses - Poisson's ratio Rigidity modulus - Bulk modulus - Relation between elastic constants - Strain energy due to axial force - Stresses and strain energy due to suddenly applied load and impact load

Unit II	TWO DIMENSIONAL STATE OF STRESS	8

Two dimensional state of stress at a point -Normal and shear stresses on any plane -Principal planes and principal stresses -Maximum shear stress -Analytical methods and Mohr's circle method -Two dimensional state of strains at a point-Principal strains and their directions. Thin Cylinder: Stresses and deformations in thin walled cylinders and spherical shells due to internal pressure

Unit III	BEAMS AND BENDING	9

Types of beams -Types of supports -Shear force and bending moment in beams -Sketching of shear force and bending moment diagrams for cantilever, simply supported and over hanging beams for any type of loading - Relationship between rate of loading, shear force and bending moment

Unit IV	STRESSES IN BEAMS	10

Theory of simple bending -Assumptions Analysis for bending stresses -Load carrying capacity of beams - Proportioning sections -Flitched beams - Leaf springs -Strain energy due to bending moment - Shear stress distribution - Strain energy due to pure shear

Unit V	TORSION OF CIRCULAR SHAFTS AND SPRINGS	8

Derivation of torsion equation -Assumptions -Theory of torsion -Stresses in solid and hollow circular shafts -Power transmitted by the shaft -Stepped shafts - Composite shafts- Strain energy due to torsion- Deformations and stresses in closed and open coiled helical springs - Stress due to combined bending and torsion

FOR FURTHER READING

Determination of principal stresses at any point in a beam - Strain rosettes

TEXT BOOK(S):

1. S. Rajput, Strength of Materials, S. Chand & Co., 2014.
2. R. K. Bansal, A Textbook of Strength of Materials, Laxmi Publications, 6th Edition 2015.

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3.	S. M. A. Kazimi, Solid Mechanics, Tata McGraw Hill Book Co Ltd., 2001.
REFERENCE(S):	
1.	P. Boresi, Richard J. Schmidt, Advanced Mechanics of Materials, 6th Edition, 2002.
2.	B. S. Basavarajaiah and P. Mahadevappa, Strength of Materials, CBS Publishers & Distributors Pvt. Ltd., 2014.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester III	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES309	FLUID MECHANICS AND MACHINERIES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Enhance the students' knowledge on fluid statics, kinematics and dynamics
- Impart knowledge on the analysis and design of water turbines and pumps

Course Outcomes: At the end of this course, learners will be able to:

- Identify the fluid- classifications, properties and their units of measurement
- Analyze the various types of flows and pressure
- Analyze the flows in circular pipes and losses in pipes
- Handle various pressure measuring instruments in the field
- Analyze the performance of turbines under different operating conditions
- Design and analyzes the efficiency of pumps

Unit I	FLUID PROPERTIES AND FLUID STATICS	9

Dimensions and units -Fluid properties - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension Fluid statics- Hydrostatic law- Pascal's law - Atmospheric, absolute, gauge and vacuum pressures - Measurement of pressure by various types of manometers - Buoyancy and meta-centre.

Unit II	FLUID KINEMATICS AND DYNAMICS	9

Fluid kinematics :Classification of fluid flow - Stream line, streak line and path line - Convective and local acceleration - Continuity equation for one, two and three dimensional flows - Stream function and velocity potential function . Fluid dynamics : Pressure, kinetic and datum energy - Euler's equations of motion - Bernoulli's theorem and proof - Application of Bernoulli's equation - Pitot tube - Orifice meter, Venturimeter.

Unit III	FLOW THROUGH PIPES	8

Development of laminar and turbulent flows in circular pipes-Laminar flow through circular tubes (Hagen Poiseuille's Equation) - Darcy-Weisbach equation for flow through circular pipe - Major and minor losses of flow in pipes- Pipes in series - Equivalent pipe- Pipes in parallel

Unit IV	OPEN CHANNEL FLOW	10

Types of flow in channel, velocity distribution, Momentum equation - Specific energy and specific force. Uniform flow – Chezy - Darcy weisbach - Mannings roughness coefficient, equivalent roughness. Computation of uniform & critical flow - the most economical sections of channel. Non-uniform flow - gradually varied flow- Dynamic equation for gradually varied flow, Relation between water surface & water surface profiles - Rapidly varied flow - hydraulic jump - energy dissipation - types - energy losses.

Unit V	PUMPS	9

Centrifugal pumps - Multistage pumps - Minimum speed to start the pump - Specific speed and characteristic curves - Reciprocating pumps - Negative slip - Indicator diagram - Functions of air vessels

FOR FURTHER READING

Methods of dimensional analysis - Rayleigh's method - Buckingham's - theorem - Hydraulic similitude - Model analysis - Types of models.

TEXT BOOK(S):

1. R. K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, 2005.
2. R. K. Rajput, A Text Book of Fluid Mechanics, S. Chand & Co., New Delhi, 2006.
3. P. N. Modi and S. M. Seth, Hydraulics and Fluid Mechanics, Standard Book House, Delhi, 2010.

REFERENCE(S):

1. V. L. Streeter and B. E. Wylie, Fluid Mechanics, McGraw Hill International Book Co., 2006.
2. Yunus A. Cengal and John M. Cimbala, Fluid Mechanics - Fundamentals and Applications (In SI

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	Units), McGraw Hill International Book Co., 2004.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19CE302	SURVEYING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on the basic principles of field surveying procedures
- Impart a clear understanding on the working principles and use of theodolite

Course Outcomes: At the end of this course, learners will be able to:

- Demonstrate the various functional aspects of surveying instruments
- Acquire knowledge in surveying by compass and plane table in the field.
- Determine the leveling, contouring, longitudinal and cross section
- Perform a highway road alignment project.
- Calculate the area and volume of earthwork

Unit I	INTRODUCTION AND CHAIN SURVEYING	9

Definition - Principles - Classification - Scales - Survey instruments, their care and adjustment - Ranging and chaining - Reciprocal ranging - Setting perpendiculars - well conditioned triangles - Traversing - Plotting - Enlarging and reducing figures.

Unit II	COMPASS SURVEYING AND PLANE TABLE SURVEYING	9

Prismatic compass - Bearing - Systems and conversions - Local attraction - True and magnetic meridians - Magnetic declination - Dip - Traversing - Plotting - Adjustment of errors by graphical and analytical methods - Plane table instruments and accessories - Methods: Radiation, Intersection, Resection and Traversing - Three and two point problems.

Unit III	LEVELLING	9

Level line - Horizontal line - Spirit level - Temporary and permanent adjustments - Fly and check levelling -Booking - Reduction - Effect of curvature and refraction - Reciprocal levelling - Longitudinal and cross sections -Plotting - Calculation of areas and volumes - Contouring - Methods - Characteristics of contours - Plotting - Earthwork volume - Capacity of reservoirs - Block contouring

Unit IV	THEODOLITE SURVEYING	9

Theodolite - Vernier and microptic - Temporary and permanent adjustments of vernier transit - Horizontal angles and their measurement - Vertical angles and their measurement - Heights and distances - Traversing - Closing error and distribution - Gales tables.

Unit V	TACHEOMETRIC SURVEYING	9

Tacheometric systems - Tangential, stadia and subtense methods - Stadia systems - Fixed hair method - Horizontal and inclined sights - Determination of Stadia constants of the tacheometer - Anallactic lens - Tangential system -Subtense measurements - Subtense bar - Direct reading tachometry.

FOR FURTHER READING

Field and office work - Conventional signs Surveyor's compass - Merits and demerits of plane table surveying Levels and Staves - Sensitiveness - Bench marks - Uses of contours - Microptic Description and uses of theodolite - Omitted measurements - Radial contouring Principles, instruments required - Vertical and normal staffing - Fixed and movable hairs

TEXT BOOK(S):

1. K. R. Arora, Surveying, Vol. I, Standard Book House, 15th Edition 2015.
2. N.N. Basak, Surveying, Tata McGraw Hill, 2007.

REFERENCE(S):

1. T. P. Kanetkar, Surveying and Levelling, Vol. I & II, United Book Corporation, 2002.
2. B. C. Punmia, Er. Ashok Kr. Jain, Dr.Arun Kumar Jain Surveying, Vol. I & II, Laxmi Publications, New Delhi, Seventeenth Edition, 2016.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG301	PRINCIPLES AND PRACTICES OF CROP PRODUCTION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To introduce agriculture and crop production.
- To acquire knowledge on crop selection and establishment
- Application of crop protection techniques for better crop production
- Acquire adequate knowledge on production practices of agricultural crops
- Acquire adequate knowledge on production practices of horticultural crops

Course Outcomes: At the end of this course, learners will be able to:

- Possesses knowledge on field and dry land agriculture
- Able to identify and select suitable crops for adequate production
- Possess knowledge on water, nutrient weed, pest and insect management.
- Possess knowledge on food, feed and fiber crops
- Possess knowledge on high value horticultural crop production and green house cultivation

Unit I	AGRICUTLURE AND CROP PRODUCTION	9

Introduction to agriculture and its crop production sub-sectors - field crop production and horticulture; Factors affecting crop growth and production: genetic (internal) and environmental (external) factors; Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices

Unit II	CROP SELECTION AND ESTABLISHMENT	9

Regional and seasonal selection of crops; Systems of crop production; Competition among crop plants; Spacing and arrangement of crop plants; Field preparation for crops including systems of tillage; Establishment of an adequate crop stand and ground cover, including selection and treatment of seed, and nursery growing.

Unit III	CROP MANAGEMENT	9

Crop water Management; Crop nutrition management - need for supplementation to soil Supplied nutrients, sources, generalized recommendations, methods and timing of application of supplemental nutrients including fertigation scheduling; Crop protection including management of weeds, pests and pathogens; Integrated methods of managing water, nutrients and plant protection; Types and methods of harvest

Unit IV	PRODUCTION PRACTICES OF AGRICULTURAL CROPS	9

Generalized management and cultivation practices for important groups of field crops in Tamil Nadu: cereal crops, grain legumes, oil seed crops, sugarcane, and fiber crops, and special purpose crops such as those grown for green manure and fodder.

Unit V	PRODUCTION PRACTICES OF HORTICULTURAL CROPS	9

Important groups of horticultural crops in Tamil Nadu such as vegetable crops, fruit crops, Flower crops; Cultivation practices of representatives of each group; Special features of production of horticultural crops - green house cultivation.

TEXT BOOK(S):

1. Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015
2. Reddy T. Sankara G.H. Yellamanda Reddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 2005

REFERENCE(S):

1. Bose T. K. and L.P.Yadav. Commercial Flowers, Naya Prakash, Calcutta.1989.

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2.	Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005
3.	Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan, I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil.1993.
4.	Kumar, N., Introduction to Horticulturell, Rajalakshmi Publications. Nagercoil, 7th edition, 2015
5.	Shanmugavel, K.G. Production Technology of Vegetable Crops. Oxford India Publications, New Delhi. 1989
6.	Handbook of Agriculture. ICAR publications, New Delhi. 2016.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester III	ES
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES310	THERMO DYNAMICS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To know the basic concepts of thermodynamics
- To study the properties of pure substances
- To know about laws of thermodynamics
- To impart knowledge on gas power cycles
- To know about chemical reaction during combustion

Course Outcomes: At the end of this course, learners will be able to:

- Adopt suitable heat exchange mechanism
- Able to select suitable substance for refrigeration
- Apply in design of refrigerator, cold storage and heat exchanger
- Design suitable mechanism for effective utilization of bio gas
- Apply knowledge in biogas production, charcoal preparation

Unit I	BASIC CONCEPTS OF THERMODYNAMICS	9

Basic concepts of thermodynamics – application areas of thermodynamics – dimensions and units closed and open systems-properties of a system – state and equilibrium – processes and cycles forms of energy and environment – temperature and zeroth law of thermodynamics-pressure and measurements – thermodynamic aspects of biological systems.

Unit II	PROPERTIES OF PURE SUBSTANCES	9

Properties of pure substances – phase and phase change – property tables – ideal gas equation other equation of state – specific heat – internal energy, enthalpy and specific heats of ideal gas – vapour pressure and phase equilibrium – energy transfer by heat, work and mass.

Unit III	FIRST LAW OF THERMODYNAMICS	9

The first law of thermodynamics-energy balance for closed and steady flow systems – energy balance for unsteady processes – the second law of thermodynamics-thermal energy reservoirs – heat engines – energy conversion efficiencies.

Unit IV	GAS POWER CYCLES	9

Gas power cycles – basic consideration in the analysis of power cycles – the Carnot cycle and its values in engineering – reciprocating engines – ottoman cycle – diesel cycle and other cycles-saving fuel – efficiency.

Unit V	CHEMICAL REACTIONS	9

Chemical reactions – fuels and combustion – theoretical and actual combustion processes – enthalpy of formation and combustion – adiabatic flame temperature – second law analysis of reacting systems – fuels cells – chemical and phase equilibrium

TEXT BOOK(S):

1. Rajput, R.K. 2010. Fourth edition. Engineering Thermodynamics. Laxmi Publication
2. Nag, P.K. 2014. Second edition. Basic and applied thermodynamics. Tata McGraw Hill Publication

REFERENCE(S):

1. Michael .J. Moran, and Howard N Shapiro 2000. Fundamentals of Engineering Thermodynamics, John Wiley & Sons. USA.
2. Valan Arasu. A. 2006. Engineering Thermodynamics, Vijay Nicole Imprints Limited Chennai-600029.
3. Vijayaraghavan, G.K. and S.Sundaravalli 2006. Engineering Thermodynamics, Lakshmi Publication, Arapakkam, Sirkali, Nagappatinam – 609 111.
4. Cengel,Y.A and Boles,M.A. Thermodynamics An Engineering Approach, McGraw hill Publication, Fifth

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edition, 2012

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Department	AGRICULTURE ENGINEERING				R 2019	Semester III	MC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks
		L	T	P	C		
19MC301	INDIAN CONSTITUTION	2	0	0	-	30	100

Course Objective (s): The purpose of learning this course is

- To Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: At the end of this course, learners will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Unit I	**HISTORY OF MAKING OF INDIAN CONSTITUTION**	**5**
History of Indian Constitution - Drafting Committee, (Composition & Working)		
Unit II	**PHILOSOPHY OF THE INDIAN CONSTITUTION**	**5**
Preamble - Salient Features		
Unit III	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**5**
Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation -Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.		
Unit IV	**ORGANS OF GOVERNANCE**	**5**
Parliament - Composition - Qualifications and Disqualifications - Powers and Functions Executive - President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions.		
Unit V	**LOCAL ADMINISTRATION**	**5**
District's Administration head: Role and Importance, - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Pachayati raj: Introduction, PRI: ZilaPachayat - Elected officials and their roles, CEO ZilaPachayat: Position and role- Block level: Organizational Hierarchy (Different departments) -Village level: Role of Elected and Appointed officials - Importance of grass root democracy.		
Unit VI	**ELECTION COMMISSION**	**5**
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women		

TEXT BOOK(S):

1. "The Constitution of India", 1950 (Bare Act), Government Publication
2. Dr. S. N. Busi, "Dr. B. R. Ambedkar Framing of Indian Constitution", 1st Edition, 2016. Ava Publishers
3. M. P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis, 2014.

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REFERENCE (s)
1. D.D. Basu , Introduction to the Constitution of India, Lexis Nexis, 2015.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester III	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19CE304	SURVEYING PRACTICAL	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on the basic principles of field surveying procedures
- Impart a clear understanding on the working principles and use of theodolite

Course Outcomes: At the end of this course, learners will be able to:

- Demonstrate the various functional aspects of surveying instruments
- Prepare topographic map including contours of any site
- Perform a highway road alignment project.
- Calculate the area and volume of earthwork

Exp No.	Name of Experiments
1	Chain surveying: Aligning, Ranging and Chaining
2	Plane table surveying: Radiation, Intersection, Traversing
3	Plane table surveying: Resection. Two and Three point problems
4	Fly levelling using Dumpy and Tilting level
5	Check levelling using dumpy level
6	Longitudinal and cross section levelling
7	Repetition and Reiteration
8	Heights and distances - Single plane method.
9	Tacheometric Constants
10	Subtense bar system to calculate distance

	Equipments	No of Equipments
1	Total Station	02
2	Theodolites	05
3	Dumpy level / Filling level	10
4	Pocket stereoscope	01
5	Ranging rods	10
6	Levelling staff	10
7	Chain	05
8	Tape	05
9	Cross staff	10
10	Arrow	10
11	Prismatic compass	05
12	Surveyor compass	05
13	Survey grade or Hand held GPS	02

TEXT BOOK(S):

1. B. C. Punmia, Surveying, Vol. I & II, Laxmi Publications, New Delhi, 2005.
2. K. R. Arora, Surveying, Vol. I, Standard Book House, 2008.

REFERENCE(S):

1. T. P. Kanetkar, Surveying and Levelling, Vol. I & II, United Book Corporation, 2002.
2. T. P. Kanetkar, Surveying and Levelling, Vol. I & II, United Book Corporation, 2002.
3. N.N. Basak, Surveying, Tata McGraw Hill, 2007.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester III	EEC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS301	COMMUNICATION SKILLS	0	0	4	2	30	100	

Course Objective (s): The purpose of learning this course is

- To involve the students in effective listening activities.
- To improve the oral communication skills in proper manner.
- To focus the effective reading of general and technical text.
- To enhance and comprehend the written text.
- To integrate LSRW skills.

Course Outcomes: At the end of this course, learners will be able to:

1. **Understand the technical talks.**
2. Communicate to his peer group properly.
3. Comprehend the general and technical text.
4. Write the reports and job application in clear manner.
5. Integrate LSRW skills.

Unit I	LISTENING	6

Listening and its importance –Listening strategies - Listen to a process information - give information, as part of a simple explanation - Being an active listener: giving verbal and non-verbal feedback - taking lecture notes

Unit II	SPEAKING	6

Give personal information - ask for personal information - express ability - ask for clarification - pronunciation basics - pronunciation practice - conversation starters: Pep talk - stressing syllables and speaking clearly - summarizing academic readings and lectures

Unit III	READING	6

Strategies for effective reading - Read and recognize different types of texts - Predicting content using photos and title - Read for details - Use of graphic organizers to review and aid comprehension - Understanding pronoun reference and use of connectors in a passage- speed reading techniques

Unit IV	WRITING	6

Plan before writing - Develop a paragraph: topic sentence, supporting sentences, concluding sentence –Write a descriptive paragraph – Write a paragraph with reasons and examples - Write an opinion paragraph – E-mail writing - Types of essays- descriptive-narrative- issue-based-argumentative-analytical

Unit V	INTEGRATION OF LSRW	6

Task based Instruction : watching a video –Listing, Sorting, ordering, comparing and analyzing the ideas – Reading a newspaper and creating topic based videos

TEXT BOOK(S):

1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011
2. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011
3. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCE(S):

1. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
2. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan:

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3. Anderson, Kenneth et al. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press 1992.

Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	BS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19BS401	STATISTICAL METHODS FOR DATA ANALYSIS	3	1	0	4	60	100	

Course Objective (s): The purpose of learning this course is to

- To provide students with the foundations of probabilistic and statistical analysis.
- To understand the knowledge of design of experiments.
- To understand the method of solving algebraic and transcendental equations using direct and indirect method.
- To understand the numerical methods of interpolation and integration.
- To introduce the numerical solution methods for solving ordinary differential equations

Course Outcomes: At the end of this course, learners will be able to:

- Ability to understand the common statistical techniques.
- Apply Analysis of Variance for the data set of selected number factors for analyzing the significance
- Apply the suitable numerical techniques to solve practical engineering problems.
- Demonstrate the concept of interpolation and numerical integration when dealing with empirical data sets.
- Make use of numerical methods in the solution of ordinary differential equations which are useful in solving engineering problems

Unit I	STATISTICS	9

Introduction of basic statistics – Probability distributions: Binomial, Poisson and Normal – Evaluation of statistical parameters for these three distributions – Regression and correlation.

Unit II	TESTING OF HYPOTHESIS	9

Introduction to Sampling distributions – Large Sample –Tests for single mean, Difference of means – Small sample – Students t-test - F-test -Chi-square test for goodness of fit – Independence of attributes using Binomial distribution.

Unit III	SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS	9

Newton Raphson method – Direct methods – Gauss Elimination method – Gauss Jordan method – Iterative methods – Gauss Jacobi and Gauss Seidel method – Matrix Inversion by Gauss Jordan method.

Unit IV	INTERPOLATION AND NUMERICAL INTEGRATION	9

Lagrange's and Newton's divided difference interpolation - Newton's forward and backward difference interpolation – Numerical Integration using Trapezoidal rule and Simpson's rule.

Unit V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	9

Taylor's series method - Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order and simultaneous equations - Adam's and Milne's predictor and corrector methods for solving first order equations.

TEXT BOOK(S):

1. S.C.Gupta and V.K.Kapoor, —Fundamentals of Mathematical Statisticsll, Sultan Chand & Sons, New Delhi, 2006.
2. P.Kandasamy, K.Thilagavathy and K.Gunavathy, —Numerical Methodsll, S.Chand & Co. Ltd. New Delhi, 2003.

REFERENCE(S):

1. Spiegel, M.R. J. Schiller and Srinivasan. R.A, —Schaum's Outlines Probability and Statistics ll, 3rd ed.,

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	Tata McGraw Hill, New Delhi, 2010.
2.	Chapra.C, Steven and Canale. P, Raymond, —Numerical Methods for Engineers ll, 5th ed., Tata McGraw Hill, New Delhi, 2007.
3.	T.Veerarajan and T.Ramachandran, —Numerical methods with Programming in Cll, 2nd ed, Tata McGraw Hill 2006, Eighth reprint-2011.
4.	Jay L.DeVore, Probability And Statistics for Engineering and the Sciences, 8th ed, Cengage learning, 2011.

Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG401	HEAT AND MASS TRANSFER FOR AGRICULTURE ENGINEER	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To gain knowledge on conduction, and laws governing conduction heat transfer
- To impart the knowledge on the laws governing convection mode of heat transfer
- To study about the radiation mode of heat transfer and laws governing
- To analyze and evaluate the performance of heat exchangers
- To gain knowledge on mass transfer and the law's governing

Course Outcomes: At the end of this course, learners will be able to:

- Able to apply conduction mode of heat transfer in concentration and drying of food materials
- Able to apply convection mode of heat transfer in concentration and drying of food materials
- Able to apply radiation mode of heat transfer in drying of food materials
- Design and alter the available heat exchanger for effective heat utilization
- Apply knowledge in mass transfer mechanism

Unit I **HEAT TRANSFER – CONDUCTION** **9**

Basic transfer processes – heat, mass and momentum – heat transfer process – conductors and insulators – conduction – Fourier's fundamental equation – thermal conductivity and thermal resistance – linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – solving problems in heat transfer by conduction.

Unit II **HEAT TRANSFER – CONVECTION** **9**

Newton Rikhman's law – film coefficient of heat transfer – convection – free and forced convection – dimensional analysis and its application – factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient – solving problems in heat transfer by convection.

Unit III **HEAT TRANSFER: RADIATION** **9**

Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff's law – Planck's law – Stefan-Boltzman's law – heat exchange through non-absorbing media – solving problems in heat transfer by radiation.

Unit IV **HEAT TRANSFER – HEAT EXCHANGER** **9**

Heat exchangers – parallel, counter and cross flow – evaporator and condensers - Logarithmic Mean Temperature Difference – overall coefficient of heat transfer – tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger – fouling factor – applications of heat exchangers – solving problems in heat exchangers.

Unit V **MASS TRANSFER** **9**

Mass transfer – introduction – Fick's law for molecular diffusion – molecular diffusion in gases – equimolar counters diffusion in gases – diffusion through a varying cross sectional area – diffusion coefficients for gases – molecular diffusion in liquids.

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TEXT BOOK(S):	
1.	Geankoplis C.J.2017. Fourth edition. Transport Processes and Separation Process Principles. Pearson India Education Services Pvt. UP.
2.	R.K.Rajput. 2002. Heat and mass transfer. S.Chand and company, Ram Nagar, New Delhi.
REFERENCE(S):	
1.	Jacob and Hawkins. 1983. Elements of Heat Transfer. John Willey and Sons Inc. New York.
2.	EcKert, E.R.G. 1981. Heat and Mass Transfer. McGraw Hill Book Co., New York.
3.	Holman, E.P.2001. Heat Transfer. McGraw-Hill Publishing Co. New Delhi.

Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG402	FARM TRACTOR SYSTEMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To gain knowledge on classification of tractors, tractor engines
- To impart the knowledge on working of engine system
- To know about the power transmission mechanism
- To develop skills on safe and efficient use of tractors
- To acquire knowledge on test procedure to assess the performance of tractors and power tillers

Course Outcomes: At the end of this course, learners will be able to:

- Able to suggest suitable tractor for different field
- Apply knowledge for effective utilization of power
- It involves effective utilization of power
- Helps to avoid accidents at farm level
- Able to test tractors and power tillers

Unit I	TRACTORS	9

Classification of tractors – Tractor engines – Principles of operation of IC engines – construction of engine blocks, cylinder head and crankcase – features of cylinder, piston, connecting rod and crankshaft – firing order – combustion chambers

Unit II	ENGINE SYSTEMS	9

Valves – inlet and outlet valves – valve timing diagram. Air cleaner – exhaust – silencer – Cooling systems – lubricating systems – fuel system – properties of fuels – governor – electrical system – engine trouble shooting.

Unit III	TRANSMISSION SYSTEMS	9

Transmission – clutch – gear box – sliding mesh – constant mesh – synchro mesh – Differential, final drive and wheels – Steering geometry – steering systems – front axle and wheel alignment – wheel ballasting – Brake – types – system.

Unit IV	HYDRAULIC SYSTEMS	9

Hydraulic system – working principles, three point linkage – draft control – weight transfer, theory of traction – tractive efficiency – tractor chassis mechanics – stability – longitudinal and lateral – Controls – visibility – operators seat – tractor safety.

Unit V	POWER TILLER AND TRACTOR TESTING	9

Power tiller – special features – clutch – gear box – steering and brake – Makes of tractors and power tillers – Types of tests – test procedure – need for testing & evaluation of farm tractor –Test code for performance testing of tractors and power tillers.

TEXT BOOK(S):	
1.	Jain, S.C. and C.R. Rai. 2016. Third Edition. Farm tractor maintenance and repair. Standard publishers

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	and distributors, New Delhi.
2.	Sanjay Kumar. 2014. Farm power resources and technologies. Kalyani Publishers. Ludhiana. Punjab.
REFERENCE(S):	
1.	Barger, E.L., J.B. Liljedahl and E.C. McKibben, 1997. Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi.
2.	Domkundwar A.V. 1999. A course in internal combustion engines. Dhanpat Rai & Co. (P) Ltd., Educational and Technical Publishers, Delhi.
3.	Black, P.O. 1996. Diesel engine manual. Taraporevala Sons& Co., Mumbai.
4.	Grouse, W.H. and Anglin, D.L. 1993. Automative mechanics. Macmillan McGraw- Hill, Singapore.
5.	Indian Standard Codes for Agril. Implements. Published by ISI, New Delhi.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19CE404	WATER RESOURCE AND IRRIGATION ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- The student is exposed to different phases in Water Resources Management and National Water Policy. Further they will be imparted required knowledge on Reservoir planning, management and economic analysis including Irrigation and Irrigation management practices.

Course Outcomes: At the end of this course, learners will be able to:

- acquire knowledge on source of water resources in India
- learn operation and management of reservoir system.
- gain knowledge on different methods of irrigation parameters
- gain knowledge on application of canal irrigation
- understand different methods of Irrigation systems

Unit I	WATER RESOURCES	9

Water resources survey – Water resources of India and Tamilnadu – Description of water resources planning – Estimation of water requirements for irrigation and drinking- Single and multipurpose reservoir – Multi objective - Fixation of Storage capacity -Strategies for reservoir operation - Design flood-levees and flood walls.

Unit II	WATER RESOURCE MANAGEMENT	9

Economics of water resources planning; – National Water Policy – Consumptive and non- consumptive water use - Water quality – Norms and Standards- IS Codes - Scope and aims of master plan - Concept of basin as a unit for development - Water budget- Conjunctive use of surface and ground water

Unit III	IRRIGATION ENGINEERING	9

Need – Merits and Demerits – Duty, Delta and Base period – Irrigation efficiencies – Crops and Seasons - Crop water Requirement – Estimation of Consumptive use of water.

Unit IV	CANAL IRRIGATION	9

Types of Impounding structures: Gravity dam – Diversion Head works - Canal drop – Cross drainage works – Canal regulations – Canal outlets – Canal lining - Kennady's and Lacey's Regime theory

Unit V	IRRIGATION METHODS AND MANAGEMENT	9

Lift irrigation – Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation - Merits and demerits – Irrigation scheduling – Water distribution – Participatory irrigation management with a case study.

TEXT BOOK(S):

1. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000.
2. Punmia B.C., et. Al. Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi, 2009
3. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23rd Revised Edition, New Delhi, 2009

REFERENCE(S):

1. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2005
2. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw- Hill Inc., New Delhi, 1997

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Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG403	MECHANICS OF FARM MACHINES	0	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To understand the mechanism of kinematics pairs and linkages
- To learn the mechanism involved in brakes and clutches
- To impart knowledge on gear and gear trains
- To know and understand different types of cam and flywheel
- To learn about working principle and applications of governors

Course Outcomes: At the end of this course, learners will be able to:

- Design suitable farm implements, material handling equipments
- Apply in tractors and power tillers
- Know the mechanism of gear and gear trains
- Understand the working of cam and flywheel
- Gain knowledge on governors

Unit I	INTRODUCTION TO MECHANISM	9

Definition of a machine - kinematic pair – types – links - types of constrained motion - types of joints - degrees of freedom - Kinematic chain - Classification of kinematic pairs - four bar chain, slider crank chain and their inversions - Mechanical advantages - determination of velocity and acceleration by relative velocity method for simple four bar and slider crank mechanism

Unit II	FRICTION AND FRICTION DRIVES	9

Brakes – band and shoe brakes – Clutches, working principles of single and multiple plate and cone clutches - Power drives - belt drives, types, belt materials, length of belt - power transmitted - velocity ratio - effect of centrifugal tension - creep and slip on power transmission

Unit III	GEAR AND GEAR TRAINS	9

Gear terminology - law of gearing - velocity of sliding between two teeth in a mesh - Involute and cycloidal profile for gear teeth - gears trains - simple, compound, reverted and epicyclic - determining velocity ratio by tabular method

Unit IV	CAM AND FLYWHEEL	9

Cam and follower – types – knife edge, roller and flat faced followers - cam nomenclature – displacement diagram – cam profiles for uniform velocity and acceleration - simple harmonic and cycloidal motion – theory of fly wheel and its applications

Unit V	GOVERNORS	9

Types of governors - constructional details and working of Watt, Porter, Proell and hartnell governors - Sensitiveness, stability, hunting, isochronisms, power and effort of a governor

TEXT BOOK(S):

1. Rattan, S.S. 1993. Theory of machines, Tata McGraw Hill Publishing Co. New Delhi.
2. Ballaney, P.L. 1994. Theory of machines. Khanna publishers. New Delhi.
3. Jagdish Lal. 1992. Theory and mechanisms and machines. Metropoliton Book Pvt. Ltd. New Delhi

REFERENCE(S):

1. Rao, J.S. and Dukkipatti, R.V. 1990. Mechanisms and machine theory, Wiley Eastern. New Delhi.
2. Thomas Beven. 1984. Theory of machines, CBS publishers and Distributors, New Delhi

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Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	HS
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19HS402	UNIVERSAL HUMAN VALUES 2 : UNDERSTANDING HARMONY	2	1	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Course Outcomes: At the end of this course, learners will be able to:

- Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
- Students would become more responsible in life, and in handling problems with sustainable solutions.
- Students become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- Students would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
- Students would have better critical ability.

Unit I	INTRODUCTION TO VALUE EDUCATION	9

Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Right Understanding, Relationship and Physical Facility - Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations

Unit II	HARMONY IN THE HUMAN BEING	9

Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body – The Body as an Instrument of the Self - Understanding Harmony in the Self - Harmony of the Self with the Body - Programme to ensure self-regulation and Health

Unit III	HARMONY IN THE FAMILY AND SOCIETY	9

Harmony in the Family – the Basic Unit of Human Interaction - Values in Human-to-Human Relationship – 'Trust' – the Foundational Value in Relationship - 'Respect' – as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order

Unit IV	HARMONY IN THE NATURE/EXISTENCE	9

Understanding Harmony in the Nature - Interconnectedness, self-regulation and Mutual Fulfillments among the Four Orders of Nature – Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence

Unit V	IMPLICATIONS OF THE HOLISTIC UNDERSTANDING	9

Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct – A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models-Typical Case Studies - Strategies for Transition towards Value-based Life and Profession

REFERENCE(S):

Chairman - BoS
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1	Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004
3	The Story of Stuff (Book)
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5	Small is Beautiful - E. F Schumacher
6	Slow is Beautiful - Cecile Andrews
7	Economy of Permanence - J C Kumarappa
8	Bharat Mein Angreji Raj – PanditSunderlal
9	Rediscovering India - by Dharampal
10	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11	Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999
TEXT BOOK(S):	
1.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93-87034-53-2

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Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG404	FARM TRACTORS AND ENGINES LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- To gain knowledge on classification of tractors, tractor engines
- To impart the knowledge on working of engine system
- To know about the power transmission mechanism
- To develop skills on safe and efficient use of tractors
- To acquire knowledge on test procedure to assess the performance of tractors and power tillers

Course Outcomes: At the end of this course, learners will be able to:

- Able to suggest suitable tractor for different field
- Apply knowledge for effective utilization of power
- It involves effective utilization of power
- Helps to avoid accidents at farm level
- Able to test tractors and power tillers

Exp No.	Name of Experiments
1	Study the working of two stroke and four stroke cycle SI and CI engines.
2	Study the valve system of an internal combustion engine and drawing valve timing diagram
3	Study of cooling system of tractor engine
4	Study of an engine lubrication system
5	Study of air cleaners of tractor engine
6	Study of gear transmission system, differential and final drive of a tractor
7	Study on power tiller
8	Study of steering mechanism of a tractor
9	Study of fuel supply system of tractor engine
10	Study of tyres, rims and ballasting methods of a tractor
11	Study of clutches and brakes

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Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG405	CROP PRODUCTION AND HUSBANDRY LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is

- To acquire knowledge on field preparation, seed selection and seed treatment
- To learn about nursery preparation
- To learn management of crops
- To learn different harvest methods
- To acquire knowledge on post harvest techniques like pre-cooling, transportation and storage

Course Outcomes: At the end of this course, learners will be able to:

- Possesses knowledge on different agronomic practices
- Prepare nursery for different crops
- Acquire adequate knowledge on crop protection
- Select suitable harvesting techniques
- Minimize post harvest losses

Exp No.	Name of Experiments
1	Field preparation studies
2	Seed selection and seed treatment procedures
3	Seed bed and Nursery preparation
4	Sowing / transplanting
5	Biometric observation for crops
6	Nutrient management Studies
7	Water management and irrigation scheduling
8	Weed management studies
9	Integrated pest management studies
10	Harvesting
11	Post harvesting
12	Study on meteorological instruments
13	Integrated farming system

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Department	CIVIL ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19CE405	HYDRAULIC ENGINEERING LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on flow measurements in pipes and open channels
- Carry out performance studies on hydraulic machineries
- At the end of the course the students will be able to design pipe layouts and design pumps for residential buildings

Course Outcomes: At the end of this course, learners will be able to:

- Measure the flow of water in pipes
- Determine the characteristics of turbines & pumps
- Understand the application of Bernoulli's theorem

Exp No.	Name of Experiments
1.	Determination of Co-efficient of discharge of Orifice meter
2.	Determination of Co-efficient of discharge of Venturimeter
3.	Determination of Co-efficient of discharge of orifice
4.	Determination of Co-efficient of discharge of V- notch
5.	Determination of Co-efficient of Impact Jet
6.	Determination of friction factor in a pipe
7.	Study on Performance Characteristics of Centrifugal pump
8.	Study on Performance Characteristics of Reciprocating pump
9.	Study on performance characteristics of Pelton Wheel Turbine
10.	Study on performance characteristics of Francis Turbine
11.	Study on performance characteristics of Kaplan Turbine

S.NO	Name of Equipments	No of Equipments
1.	Rotameter	01
2.	Venturimeter / Orificemeter	01
3.	Bernoulli's Experiment	01
4.	friction loss apparatus	01
5.	Centrifugal pumps	01
6.	Gear pump	01
7.	Submersible pump	01
8.	Reciprocating pump	01
9.	Pelton wheel turbine	01
10.	Francis turbine/Kaplan turbine	01

TEXT BOOK(S):

1. Applied hydraulics and hydraulic machinery by Dr.R.K.Rajput.
2. Subramanya, K., 1991. Flow in open channels, Tata McGraw-Hill New Delhi.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES501	CROP PROCESS ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- know the importance of moisture content during harvesting, threshing and storage of non perishable crops
- gain knowledge on engineering properties and psychrometry and its uses
- know the different types of cleaning, grading and material handling equipments
- acquire knowledge on availability of different dryers and storage structures
- gain knowledge on milling of cereals, pulses and oil seeds

Course Outcomes: At the end of this course, learners able to:

- apply the technology to Minimize post harvest losses
- Design material handling equipment, storage structures and dryers for different type of crops
- design cleaners, graders an conveying equipments
- design or alter the existing methods of drying and storage structure to minimize post harvest losses
- apply various technique to minimize post harvest losses during milling

Unit I	INTRODUCTION	9

Post harvest engineering – introduction – objectives – post harvest losses of durables and perishables– importance – optimum stage of harvest. Threshing – traditional methods mechanical threshers – types – principles and operation –moisture content – measurement - direct and indirect methods – moisture meters – equilibrium moisture content.

Unit II	PHYSICAL PROPERTIES AND PSYCHROMETRY	9

Physical properties of agricultural produces. Psychrometry – importance – Psychrometric charts and its uses –humidification operations, gas-liquid contents, gas laws and their application in determining psychrometric properties of air-water-vapour mixture.

Unit III	CLEANING, GRADING AND MATERIAL HANDLING	9

Principles – air screen cleaners – types – adjustments – cylinder separator – spiral separator – magnetic separator – colour sorter – inclined belt separator – length separators – effectiveness of separation and performance index. Different types of graders for cereals, pulses and oil seed crops. Materials handling – belt conveyor – screw conveyor – bucket elevators – pneumatic conveying.

Unit IV	DRYING AND STORAGE	9

Drying – principles and theory of drying – drying curves - rate of drying - falling rate - constant rate, critical moisture content - thin layer and deep bed drying – Hot air drying – methods of producing hot air

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– Types of grain dryers – selection – construction, operation and maintenance of dryers – Design of dryers. Direct and indirect types of damages – sources of infestation, traditional and modern types of storage structures – vertical, horizontal and underground storages – storage structure designs.		
Unit V	PROCESSING OF CEREALS, PULSES AND OILSEEDS	**9**
Paddy processing – parboiling of paddy – methods – merits and demerits – dehusking of paddy – rubber roll sellers - construction details - merits and demerits – rice polishers – types – constructional details – polishing – layout of modern rice mill – performance evaluation of modern mills. Wheat milling. Pulse milling methods – Wet, Dry, CFTRI, CIAE, Punjab. Oil seed processing. Principles and operation – maize sheller, husker sheller for maize – groundnut decorticator – castor sheller.		
REFERENCE(S):		
1.	Henderson, S.M. and R.L.Perry. 1995. Agricultural process engineering, John Willey and Sons, New York.	
2.	Pandey, P.H. 1994. Principles of agricultural processing, Kalyani Publishers, Ludhiana,	
3.	N.N. Mohsenin, Physical Properties of Plant And Animal Materials, Gordon and Breach publishers, New York, 1986	
4.	W.L. McCabe and J.C. Smith, Seventh Edition. Unit Operations of Chemical Engineering, McGraw Hill Education (India) Pvt. Ltd, Tokyo, 2015	
Text books		
1.	Chakraverty, A. 2017. Third Edition. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing & Co. Pvt. Ltd., New Delhi.	
2.	Sahay, K.M. and K.K. Singh. 2004. Second revised and enlarged edition. Unit operations in Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi,	
3.	Ojha, T.P. and A.M. Michael. 2018. Tenth edition. Principles of Agricultural Engineering. Vol.- 1. Jain Brothers, New Delhi.	

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG501	Farm Mechanization, Tillage and Sowing Equipment	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- gain knowledge on various farm mechanization operations
- impart knowledge on primary tillage equipment
- impart knowledge on secondary tillage equipment
- understand the basic principle involved and methods of sowing equipment
- know the fertilizer application methods

Course Outcomes: At the end of this course, learners will be able to:

- effectively utilize the implements for better production
- select and calculate the forces involved in primary tillage implements
- select and adjust the various secondary tillage equipment
- select and test the sowing equipment
- select suitable fertilizer applicators

Unit I	FARM MECHANIZATION	9

Farm mechanization – status and challenges. Tillage – methods – primary tillage implements – secondary tillage implements – animal drawn ploughs – construction. Types of farm implements – trailed, mounted and semi mounted implements. Field capacity.

Unit II	PRIMARY TILLAGE EQUIPMENT	9

Mould board plough – attachments – mould board shapes and types. Forces acting on tillage tool – mould board plough. Disc plough – force representation on disc – Types of disc ploughs – Subsoiler plough – Rotary plough – spading machine – coir pith applicators.

Unit III	SECONDARY TILLAGE EQUIPMENT	9

Cultivators – types – construction – adjustments. Disc harrows – Bund former – ridger – leveller. Basin lister – Wetland preparation equipment – puddler – cage wheel – leveller. Hitch systems – vertical and horizontal hitching of pull type and mounted equipment – force analysis on trailed, mounted and semi mounted equipment.

Unit IV	SOWING EQUIPMENT	9

Sowing and planting – methods – row crop planting systems. Seeding machines – Devices for metering seeds – furrow openers – furrow closers – types – Types of seed drills and planters - calibration of seed drill and planters.

Unit V	FERTILIZER APPLICATION EQUIPMENT	9

Fertilizer Application methods – metering devices – seed cum fertilizer drill – application of liquid

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fertilizers - manure spreaders.	
REFERENCE(S):	
1.	Donnell Hunt. 2013. Farm power and machinery management. Scientific International Pvt. Ltd. New Delhi.
2.	Harris Pearson Smith et al. 1996. Farm machinery and equipments. Tata McGraw-Hill pub., New Delhi.
3.	Kepner, R.A., R.Bainer, E.L. Barger. 2005. Third Edition. Principles of farm machinery. CBS Publishers and Distributers, Delhi.
4.	Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi
TEXT BOOK(S):	
1.	Jagdishwar Sahay. 2006. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6
2.	Ojha T.P. and A.M. Michael. 2018. Tenth edition. Principles of Agricultural Engineering, Vol – 1. Jain Brothers, New Delhi.
3.	Senthilkumar, T., R. Kavitha and V.M.Duraisamy 2015. A Text Book of Farm Machinery, Thannambikkai Publications, Coimbatore . ISBN: 978-9381102305

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG502	UNIT OPERATIONS IN AGRICULTURAL PROCESSING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- introduce scope, importance and key concepts of agro processing
- expose the fundamentals of various unit operations of processing industries such as evaporation, concentration, mechanical separation, size reduction equipment, etc.
- Acquire the knowledge on distillation, membrane separation needed for the extraction of liquid fuels such as ethanol, methanol, etc

Course Outcomes: At the end of this course, learners will be able to:

- Examine the evaporation process and types of evaporators for food industry
- Analyze the principles of filtration and mechanical separation equipment
- Identify size reduction and grinding equipment and understand the factors affecting the process
- Identify the gas-liquid and solid-liquid equilibrium concepts and factors influencing equilibrium separation process.
- Differentiate crystallization and distillation processes and identify processing equipment.

Unit I	EVAPORATION AND CONCENTRATION	8

Unit operations in food processing - conservation of mass and energy - overall view of an engineering process-dimensions and units - dimensional and unit consistency - dimensionless ratios-evaporation - definition - liquid characteristics - single and multiple effect evaporation- types of evaporators performance of evaporators and boiling point elevation - capacity - economy and heat balance - evaporation of heat sensitive materials

Unit II	MECHANICAL SEPARATION	8

Filtration - definition - filter media - types and requirements-constant rate filtration constant pressure filtration - filter cake resistance-filtration equipment - rotary vacuum filter - filter press sedimentation - gravitational sedimentation of particles in a fluid - Stoke"s law, sedimentation of particles in gas-cyclones - settling under sedimentation and gravitational sedimentation-centrifugal separations - rate of separations - liquid-liquid separation - centrifuge equipment

Unit III	SIZE REDUCTION AND MIXING	9

Size reduction - grinding and cutting - principles of comminuting - characteristics of comminuted products - particle size distribution in comminuted products-energy and power requirements in comminuting - crushing efficiency - Rittinger's, Bond's and Kick's laws for crushing-size reduction equipment - crushers - jaw crusher, gyratory crusher-crushing rolls - grinders - hammer mills-rolling compression mills - attrition, rod, ball and tube mills - construction and operation. Mixing - Characteristics of mixtures - Measurement of mixing sample size sample compositions - Particle mixing - mixing index - Rates of Mixing - mixing times - Energy Input in Mixing equipment.

Unit IV	CONTACT EQUILIBRIUM SEPARATION	10

Contact equilibrium separation processes - concentrations - gas-liquid and solid-liquid equilibrium - equilibrium concentration relationships - operating conditions-calculation of separation in contact equilibrium processes-gas absorption - rate of gas absorption - stage - equilibrium gas absorption and equipment-properties of tower packing - types - construction - flow through packed towers-extraction -

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rate of extraction stage equilibrium extraction-equipment for leaching coarse solids intermediate solids - basket extractor-extraction of fine material - Dorr agitator - continuous leaching decantation systems - extraction towers-washing equipment		
Unit V	CRYSTALLIZATION AND DISTILLATION	**10**
Crystallization - equilibrium -solubility and equilibrium diagram - rate of crystal growth - equilibrium crystallization-crystallization equipment - classification - construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation - binary mixtures - flash and differential distillation-steam distillation - theory - consumption - continuous distillation with rectification - vacuum distillation - batch distillation - operation and process - advantages and limitations - azeotropic distillation-distillation equipment - construction and operation - factors influencing the operation.		
REFERENCE(S):		
1.	Geankoplis,C.J., Transport Process and Unit Operations, Prentice-Hall of India Private Limited, New Delhi, 1999	
Text books		
1.	Coulson,J.M. and J.F. Richardson, Chemical Engineering, Volume I to V. The Pergamon Press, New York, 1999	

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG503	SOLAR AND WIND ENERGY ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- learn about the fundamental aspects of solar energy availability, solar energy conversion technologies
- understand about the fundamental aspects of wind energy availability and wind power generators
- acquire the knowledge on the alternate sources of energy such as geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and energy storage

Course Outcomes: At the end of this course, learners will be able to:

- Understand the basics of solar energy and solar thermal energy conversion technologies and compare direct mode and indirect mode solar dryers
- Analyse the principles and applications of solar thermal power stations, solar pond, and solar stills
- Understand the wind power laws and calculate the torque and power characteristics of wind energy
- Design wind mills and test the units for certification
- Understand the principles of geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and analyse their applications

Unit I	SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS	9

Solar radiation availability - radiation measurement -transmittance - absorptance flat plate collectors - heat transfer correlations - collector efficiency - heat balance -absorber plate - types - selective surfaces. Solar driers types heat transfer performance of solar dryers agro industrial applications.

Unit II	SOLAR CONCENTRATING COLLECTORS AND PV TECHNOLOGY	9

Optically concentrating collectors- types reflectors - solar thermal power stations principle and applications - solar stills- types- solar pond performance- characteristics applications. Photovoltatics types characteristic- load estimation batteries invertors operation system controls. PV system installations standalone systems- PV powered water pumping system sizing and optimization hybrid system solar technologies in green buildings.

Unit III	WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND	9

Nature of wind - wind structure and measurement - wind power laws - velocity and power duration curves- aero foil - tip speed ratio - torque and power characteristics power coefficients - Betz coefficient

Unit IV	WIND MILL DESIGN AND APPLICATIONS	9

Turbines- Wind mill - classification - power curve. Upwind and downwind systems - transmission rotors - pumps - generators - standalone system - grid system -batteries. Wind energy storage - wind farms -

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wheeling and banking - testing and certification procedures..		
Unit V	ALTERNATE ENERGY SOURCES	**9**
Ocean energy - off shore and on shore ocean energy conversion technologies - OTEC principles - open and closed cycles. Tidal energy - high and low tides - tidal power - tidal energy conversion. Geothermal energy - resources - classification and types of geothermal power plants. Nuclear energy - reactions - fusion, fission, hybrid reactors. Fuel cell - principle and operation - classification and types. Energy storage- pumped hydro and underground pumped hydro - compressed air - battery - flywheel - thermal.		

REFERENCE(S):

1. Solanki, C.S. "Solar Photovoltaic Technology and Systems", PHI learning Pvt. Ltd., New Delhi, 2013.
2. Rai. G.D. "Non Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002.
3. Rao. S and B.B. Parulekar. "Energy Technology – Non conventional, Renewable and Conventional". Khanna Publishers, Delhi, 2000.
4. Rajput. R.K. "Non- Conventional Energy Sources and Utilization", S. Chand & Company Pvt. Ltd, New Delhi, 2013.

Text books

1. Rai., G.D. "Solar Energy Utilization "Khanna publishers, New Delhi, 2002.
2. More, H.S and R.C. Maheshwari, " Wind Energy Utilization in India" CIAE Publication – Bhopal, 1982.
3. Solanki, C.S. "Renewable Energy Technologies: A Practical guide for beginners". PHI learning Pvt. Ltd, New Delhi. 2008.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester IV	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG504	SOIL MECHANICS FOR AGRICULTURE ENGINEERS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Make the students gain adequate knowledge on the index and engineering properties of soils
- Understand the significance of the soil properties

Course Outcomes: At the end of this course, learners will be able to:

- Determine the index properties of soil and classify the type of soil
- Determine the permeability and seepage characteristics of soil
- Determine the compressibility characteristics and shear strength parameters of soil
- Determine the failure analysis of different soil parameters
- Analyze the stability of slopes and provide slope protection methods

Unit I	INDEX PROPERTIES AND CLASSIFICATION OF SOIL	9

Nature of soils - Phase diagrams - Basic definitions and inter-relationships - Index properties of soils and their determinations: Specific gravity - Water content - Density - Relative density - Sieve analysis - Particle size distribution - Sedimentation analysis - Consistency of soils - Atterberg limits and indices - Classification of soils: Need - Classification based on BIS - Field Identification of Soils

Unit II	SOIL WATER AND WATER FLOW	9

Soil water - Various forms - Static pressure in water - Capillary flow - Suction - Effective stress concept - Total - Neutral and effective stress distribution in soils - Flow of water through soils - Darcy's law; Assumptions and validity - Permeability - Coefficient of permeability - Laboratory test and Field test - Factors affecting permeability: Permeability of stratified deposits of soils - Seepage - Laplace equation - Introduction to Flow nets.

Unit III	COMPRESSIBILITY OF SOILS	9

Compaction - Factors affecting compaction - Effect of compaction on soil properties - Proctor and modified Proctor tests - Zero air void lines - Field compaction and its control - Consolidation - Fundamental definitions - Spring analogy - Terzaghi's one dimensional consolidation theory - Pre-consolidation pressure and its determination - Normally, under and over consolidated soils-Time rate of consolidation

Unit IV	VERTICAL STRESS AND SHEAR STRENGTH	10

Stresses in soils: Boussinesq's and Wester Guard's theories of stresses due to concentrated loads - Circular, Rectangular load - Strip load - New Mark's chart - Pressure bulbs - Shear strength - Factors affecting shear strength of soils- Mohr - Coulomb theory - Measurement of shear parameters - Direct

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shear - Unconfined compression - Triaxial - Drained and un-drained conditions - Vane shear tests		
Unit V	**STABILITY OF SLOPES**	**8**
Types of slopes - Failure mechanism of slopes - Total and effective stress analysis - Finite slopes - Stability analysis for purely cohesive and c-phi soils - Method of slices - Friction circle method - Taylor's Stability number - Slope protection methods		

TEXT BOOK(S):

1. B. N. D. Narasinga Rao, Soil Mechanics and Foundation Engineering, Wiley India Pvt. Ltd., New Delhi, 2015.
2. B. C. Punmia, Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., New Delhi, 2005.
3. Alam Singh, Soil Engineering in Theory and Practice, Asia Publishing House, Bombay, 2nd Edition, 2009.

REFERENCE(S):

1. Karl Terzaghi, Soil Mechanics in Engineering Practice, 3rd edition, John Wiley & Sons, Inc, 1995.
2. IS Codes: IS 1498: 1970, IS 2810: 1979, IS 2809: 1972, IS 2720 : Part 1 to Part 41

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG505	OPERATION AND MAINTENANCE OF FARM MACHINERY LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- To understand the tractor system
- To impart knowledge on hitching and operating of implements with the tractor
- To understand the periodical maintenance of various farm implements and equipment
- To understand the operating mechanism of seed drill with tractor
- To study the trouble shooting and remedies in tractor

Course Outcomes: At the end of this course, learners will be able to:

- Able to identify the major tractor system
- Able to hitch and operate farm implements with the tractor
- Able to implement various maintenance techniques for various farm implements and equipment
- Able to operate, adjust seed drill with tractor
- Able to take remedial action for maintenance for tractor

Exp No.	Name of Experiments
1	Identification of major systems of a tractor and general guidelines and preliminary check measures
2	Practicing of Tractor Driving
3	Practice in hitching and operating the mould board plough with the tractor – operational adjustments, maintenance and safety aspects
4	Practice in hitching and operating the disc plough with the tractor – operational adjustments, maintenance and safety aspects
5	Practice in hitching and operating the rotovator with the tractor – operational adjustments, maintenance and safety aspects
6	Practice in hitching and operating cultivator with tractor – operational adjustments, maintenance and safety aspects
7	Study on periodical maintenance – maintenance and safety aspects for various tillage implements and sowing equipment attached to the tractor and weeding equipment
8	Practice in operating seed drill with tractor – operational adjustments, maintenance and safety aspects

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9	Practice in operating trailer with tractor – operational adjustments, maintenance and safety aspects
10	Study on the trouble shooting and remedies in tractor, periodical maintenance aspects of tractor including tyre and battery

	Equipment	No of Equipment
1	Tractor	01
2	Power tiller	01
3	Disc plough	01
4	Disc harrow	01
5	Multi tyne cultivator	01
6	Paddy Transplanter	01
7	Seed drill	01
8	Sprayer	01
9	Mower	01
10	Weeder	01
11	Combine harvester (optional) – can be had as demonstration	01

TEXT BOOK(S):

1.	Jain, S.C. and C.R. Rai. Farm Tractor Maintenance and Repair. Standard publishers and Distributors, New Delhi, 1999.
2.	Herbert L.Nichols Sr., Moving the Earth, D. Van Nostrand company Inc. Princeton, 1959.

REFERENCE(S):

1.	John A Havers and Frank W Stubbs, Hand book of Heavy Construction, McGraw – Hill book Company, New York, 1971.
2.	Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG506	CROP PROCESS ENGINEERING LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- To know the moisture content determination methods
- To gain knowledge to determine engineering properties of agricultural produces and products
- To know the different types of cleaning, grading equipment
- To gain knowledge on different material conveying equipment
- To know the shelling methods of cereals

Course Outcomes: At the end of this course, learners will be able to:

- Able to minimize post harvest loss during storage, milling
- Able to design various post harvest equipment
- Able to design cleaners and graders
- Able to design different conveying equipment
- Able to design or alter the existing methods to minimize post harvest loss

Exp No.	Name of Experiments
1	Determination of moisture content of grains, potato slice by oven-dry method and draw the drying characteristic curves
2	Determination of true density, bulk density and porosity of grains
3	Determination of coefficient of friction and angle of repose of grains
4	Evaluation of efficiency of grain cleaning cum grading machine
5	Evaluation of cleaning efficiency of spiral separator
6	Evaluation of cleaning efficiency of inclined belt separator
7	Determination of conveying efficiency of bucket elevator
8	Determination of conveying efficiency of screw conveyor
9	Performance evaluation of paddy parboiling drum
10	Evaluation of shelling efficiency of rubber roll Sheller
11	Visit to modern rice mill / pulse / oil milling industries / flour industries

	Equipment	No of Equipment
1	Hot air oven, Grain moisture meter	01
2	Porosity apparatus	01
3	Coefficient of friction apparatus	01

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4	Angle of repose – round type and L type	01
5	Paddy thresher	01
6	Groundnut decorticator and maize Sheller	01
7	Thin layer dryer	01
8	LSU dryer	01
9	Bucket elevator and screw conveyor	01
10	Rubber roll Sheller	01
11	Oil expeller	01

TEXT BOOK(S):

1.	Chakraverty, A. Post harvest technology for Cereals, Pulses and Oilseeds. Oxford & IBH Publication Pvt Ltd, New Delhi, Third Edition, 2000.
2.	Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 1994.

REFERENCE(S):

1.	Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994.
2.	Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955
3.	Mohsenin, N.N. Physical Properties of Plant and Animal Materials Gordon and Breach Publishers, Ludhiana, 1970.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG601	FOOD AND DAIRY ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- acquire better understanding of the food concentration and thermal processing of foods
- know the physical and thermal properties of milk and different methods of milk processing and milk products
- gain knowledge on the theory, methods, and equipment for the various unit operations of dairy industry

Course Outcomes: At the end of this course, learners will be able to:

- Explain physical, mechanical, thermal, rheological and electrical properties of food material and appraise their importance in food processing
- Distinguish various thermal treatment techniques for food products and select suitable thermal processing method for food products based on their properties
- Compare food drying systems and assess their limitations in applying different food products
- Explain physical, chemical and thermal properties of milk and compare milk processing techniques
- Design various milk processing equipment and evaluate their performance

Unit I	PROPERTIES OF BIOLOGICAL MATERIALS	8

Constituents of food and their energy values - Physical, mechanical, thermal, rheological, electrical and physico-chemical properties of biological materials- texture of biological materials - definition - Terminologies - viscometry - basic concepts - Concentrations of foods - freeze concentration - membrane concentration

Unit II	THERMAL PROCESSING OF FOODS	12

Thermal processing of foods - product-time-temperature relationships - cooking, blanching pasteurization techniques- UHT Processing - sterilization of solid and liquid foods- interaction of heat energy on food components - kinetics of microbial destruction - Decimal reduction time - Temperature dependence of kinetics - Arrhenius equation - Thermal Death Time Curves - 12D concepts - calculation of process time - Ball's formula method - loss of nutrient in Newtonian and non-Newtonian liquid foods - batch and continuous sterilization equipment. Preservation by retort processing - principles and applications - microwave and radio frequency heating in food processing- Canning- Aseptic packaging.

Unit III	DRYING AND DEHYDRATION	9

Food spoilage - causes for spoilage -Moisture content - free moisture - bound and unbound moisture - equilibrium moisture content - Water activity - sorption behaviour of foods - types of dryers - drum, spray, dryers-advantages and disadvantages - dehydration - methods of dehydration osmotic dehydration

Unit IV	MILK PROCESSING	6

Physical, chemical, thermal and rheological properties of milk - storage tanks. Receiving handling and testing of milk - storage. Pasteurization - application- equipment - Low Temperature Long Time - High Temperature Short Time - Ultra High Temperature pasteurization

Unit V	DAIRY EQUIPMENT AND PRODUCTS	10

Homogenisation - theory and working of homogenisers - high pressure homogenization of milk and other

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food suspensions - design criteria for homogenizing equipment- cream separation principles - types of separators. Clarifiers - butter churns - ghee manufacture - equipment - whey manufacture- techniques - equipment - ice cream freezers - condensed milk - milk powder manufacturing drying equipment - spray drier - milk products - paneer - casein - probiotic dairy products - kefir- milk plant sanitation requirements - Cleaning in-place and its functions.	
REFERENCE(S):	
5.	H.G.Kessler, Food Engineering and Dairy Technology, Freising, Germany, Verlag A.Kessler, 1981
6.	Norman N. Potter and Joseph H. Hotchkiss, Food Science, Fifth Edition, Food Science Text Series, 3. ISBN: 978-1-4613-7263-9 (Print) 978-1-4615-4985-7 (Online), 1995
7.	Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
8.	Sukumar De, Outlines of Dairy: Technology, Oxford University Press, 2001
Text books	
1	R.Paul Singh and R.Dennis Heldman, Introduction to Food Engineering. Third Edition, Academic Press, London, 2004.
2	R.M. Teledo, Fundamentals of Food Process Engineering, 2nd Ed. Van Nostrand Reinhold, New York, 1991.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG602	PLANT PROTECTION AND HARVESTING MACHINERY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- impart knowledge on interculture equipment
- study about types, parts and function of sprayers
- understand the duster application, care and maintenance
- gain knowledge on working principle of various harvesting equipments.
- understand the construction and working of threshers and other machineries

Course Outcomes: At the end of this course, learners will be able to:

- select and design interculture equipment
- calculate the particle size and area covered by different sprayers
- maintain the duster for effective utilization
- select suitable harvesting equipment
- use fruit pluckers, tree shakers, post hole diggers and chaff cutter

Unit I	WEEDING EQUIPMENT	9

Weeding and Interculture equipment. Junior hoe - guntaka - blade harrow - dry land weeders - tractor mounted and engine operated sweeps. Engine operated and rotary weeders for upland and low land - selection, constructional features and adjustments.

Unit II	SPRAYERS	9

Sprayers – classifications - parts and accessories - atomizers - agitators - determination of particle size and distribution. Number Median Diameter (NMD) and Volume Median Diameter (VMD). Sprayer operation – boom sprayer - precaution - coverage - factors affecting drift. Rotating disc sprayers – Controlled Droplet Application (CDA) - Electrostatic sprayers - Arial spraying. .

Unit III	DUSTERS	9

Dusters - types - mist blower cum duster - other plant protection equipment like drown- operation, repair and maintenance.

Unit IV	HARVESTERS	9

Principles and types of cutting mechanisms. Harvesters - types - mower mechanism – construction and adjustments - registration and alignment. Mowers, windrowers, reapers, reaper binders and forage harvesters. Diggers for potato, groundnut and other tubers. Sugarcane harvesters - cotton pickers - corn harvesters. .

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Unit V	THRESHERS AND OTHER MACHINERIES	9
Thresher – construction and working of multi crop thresher. Combine harvester – types - parts - construction and working. Fruit pluckers - tree shakers - fruit harvesting machinery. Forest machinery - shrub cutters - tree cutting machines – post hole diggers – Chaff cutter.		
REFERENCE(S):		
1.	Sanjay Kumar. 2013. Fundamentals of Agricultural Engineering. Kalyani publishers, Ludhiana - 141 008.	
2.	Surendar singh, 2011. Farm Machinery Principles and Applications. Indian Council of Agricultural Research, New Delhi-12.	
Text books		
1.	Kepner, R.A., R.Bainer and E.L. Barger. 2005. Third Edition. Principles of farm machinery. CBS Publishers and Distributers, Delhi.	
2.	Donnell Hunt. 2013. Farm power and machinery management. Scientific International Pvt. Ltd. New Delhi.	
3.	Jagdishwar Sahay. 2006. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6	
4.	Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi	
5.	senthilkumar, t., r. kavitha and v.m.duraisamy 2015. a text book of farm machinery, thannambikkai publications, coimbatore. isbn: 978-9381102305	

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG603	IRRIGATION ENGINEERING LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- Students should be able to verify the principles studied in theory by performing the experiments in lab.

Course Outcomes: At the end of this course, learners will be able to:

- acquire the knowledge on various meteorological instruments and understanding the concept of different irrigational systems in the laboratory tests.

Exp No.	Name of Experiments
1	To study various instruments in the Meteorological Laboratory
2	Determination of infiltration rate using double ring and digital infiltrometer
3	Determination of soil moisture wetting pattern for irrigation scheduling
4	Design and evaluation of Drip irrigation system
5	Design and evaluation of sprinkler irrigation system
6	Measurement of flow properties in open irrigated channels (flumes, notches)
7	Evaluation of surface irrigation methods
8	Determination of uniformity coefficient for drip irrigation system
9	Determination of uniformity coefficient for sprinkler system (catch can method)
10	To conduct experiment on disc filter for micro irrigation systems

	Equipment	No of Equipment
1	Meteorological lab with Cup counter anemometer, Sunshine recorder, Open pan evaporimeter, Stevenson's screen - Dry bulb, wet bulb thermometers, recording and nonrecording type rain gauge etc	01
2	Double ring infiltrometer	01
3	Digital infiltrometer	01
4	Parshall flume, cut throat flume	01
5	V notch, Rectangular notch and trapezoidal notch	01
6	Drip irrigation system with all accessories	01
7	Sprinkler irrigation system with all accessories	01
8	Required number of stop watches	

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9	Weighing balance, rain gun	01
10	Catch cans, measuring jars – required numbers	
TEXT BOOK(S):		
1.	Laboratory Manual, Centre for Water Resources, Anna University, Chennai.	
REFERENCE(S):		
1.	Michael, A.M., "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.	
2.	Asawa, G.L., "Irrigation Engineering", New Age International Private Limited, New Delhi, 1996.	

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG604	FOOD PROCESS ENGINEERING LABORATORY	0	0	4	2	60	100	

Course Objective (s): The purpose of learning this course is to

- To get hands on experience on various aspects of food science and food process engineering.

Course Outcomes: At the end of this course, learners will be able to:

- On completion of the lab course, the students will be able to get experience on various aspects of food processing, preservation.

Exp No.	Name of Experiments
1	Determination of cooking properties of parboiled and raw rice.
2	Estimation of microbial load in food materials.
3	Determination of rehydration ratio of dehydrated foods.
4	Experiment on osmotic dehydration of foods
5	Experiment of food extruder
6	Experiment on properties of food through microwave oven heating.
7	Determination of properties of milk
8	Experiments on cream separator to determine the separation efficiency
9	construction and operation of butter churn and butter working accessories
10	Experiments on detection of Food Adulteration
11	Estimation of protein in food.
12	Experiment on expansion and Oil absorption characteristic of snacks on frying
	The lab includes visit to food processing and dairy industry

	Equipment	No of Equipment
1	Extruder	01
2	Pasteurizer	01
3	Hot air oven	01
4	Hand refractometer	01
5	Dessicator	01
6	Dean and Stark"s apparatus	01
7	Cabinet dryer	01
8	Soxhlet flask	01

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9	Distillation column	01
10	Kjeldahl flask.	01
11	Distillation apparatus.	01
12	Microwave oven	01
13	Cream separator	01
14	Butter churner	01

TEXT BOOK(S):

1.	Singh, R.Paul. and Heldman, R.Dennis.2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.
2.	Kessler, H.G.1981. Food engineering and dairy technology. Verlag A.Kessler, Freising.

REFERENCE(S):

1.	Walstra, P. T.J. Geurts, A. Nooman, A. Jellema and M.A. J.S Van Boekel. 2005. Dairy Technology. Marcel Dekker Inc. New york.
2.	Clunie Harvey, W.M and Harry Hill. 2009 Milk Products. IV Edition Biotech Books, New Delhi.
3.	Robinson, R.K.1986. Modern dairy technology Vol.I Advances in Milk processing. Elsevier Applied Science Publishes, London.
4.	Charm, S.E.1971. The fundamentals of Food engineering, AVI pub.Co.,Inc,
5.	Karel Marcus, Fennama, R.Owen and Lund, B.Dayal. 1975. Principles of food science, Part II - Physical principles of food preservation, Marcel Dakker, Inc.
6.	Hall,C.W and T.J.Hedrick. 1971. Drying of milk and milk products. AVI Publishing Co., West Port, Connecticut.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	ES
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19ES701	PRINCIPLES OF MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Course Outcomes: At the end of this course, learners will be able to:

- Understand the basic concepts of Management.
- Have some basic knowledge on planning process and its Tools & Techniques.
- understand management concept of organizing and staffing.
- understand management concept of directing.
- understand management concept of controlling.

Unit I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9

Definition of Management -Science or Art - Manager Vs Entrepreneur- types of managers - Managerial roles and skills - Evolution of Management - Scientific, Human Relations, System and Contingency approaches - Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises-Organization culture and Environment -Current Trends and issues in Management.

Unit II	PLANNING	9

Nature and purpose of planning-Planning process-Types of planning - Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

Unit III	ORGANISING	9

Nature and purpose - Formal and informal organization - Organization chart - Organization Structure and Types - Line and staff authority - Departmentalization - delegation of authority - Centralization and decentralization - Job Design-Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

Unit IV	DIRECTING	9

Foundations of individual and group behaviour - Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership - types and theories of leadership - Communication - Process of communication - Barrier in communication - Effective communication -

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Communication and IT.		
Unit V	CONTROLLING	9
System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance - Direct and preventive control -Reporting.		
REFERENCE(S):		
1.	Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.	
2.	Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education,7th Edition, 2011.	
3.	Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.	
Text books		
1.	L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007..	
2.	P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008	

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AG701	BIO-ENERGY RESOURCE TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- impart the fundamental knowledge on the importance of Bio resources, Bio energy and reactors.
- Alcohol and ethanol production and
- Energy and Environment

Course Outcomes: At the end of this course, learners will be able to:

- understand the concepts of bio energy sources and its applications.

Unit I	BIO RESOURCE - AN INTRODUCTION`	**09**

Bio resource – origin – biomass types and characteristics- biomass conversion technology- Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance.

Unit II	BIO ENERGY	**09**

Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation.

Unit III	BIO REACTORS AND FERMENTORS	09

Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Down stream processing-Recovery and purification of products.

Unit IV	ALCOHOL PRODUCTION	**09**

Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis - Antibiotics enzymes- principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers.

Unit V	ENERGY AND ENVIRONMENT	**09**

Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – – Bioenergy policy.

REFERENCE(S):

1. Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986

Text books

1. Rai G.D,Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
2. Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX01	SYSTEMS ANALYSIS AND SOFT COMPUTING IN AGRICULTURAL ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- understand the basic concept of system engineering
- impart knowledge on linear programming and dynamic programming
- understand the basic principle and concept of simulation
- gain knowledge on neural network
- understand basic concepts and properties of fuzzy logic

Course Outcomes: At the end of this course, learners will be:

- Able to apply system approach for water resources and irrigation
- Able to apply linear programme techniques in agricultural operations
- Able to apply simulation technique in irrigation scheduling
- Able to apply neural network in agricultural operations
- Able to apply fuzzy logic in agricultural operations

Unit I	SYSTEM CONCEPTS	9

Definition, classification, and characteristics of systems – Scope and steps in systems engineering – Need for systems approach to water resources and irrigation.

Unit II	LINEAR PROGRAMMING & DYNAMIC PROGRAMMING	9

Introduction to operations research – Linear programming, problem formulation, graphical solution, solution by simplex method – Sensitivity analysis – application – Bellman's optimality criteria, problem formulation and solutions – application.

Unit III	PROTECTED CULTIVATION OF FLOWER CROPS	9

Basic principles and concepts – Random variate and random process – Monte Carlo techniques – Model development – Inputs and outputs – Deterministic and stochastic simulation – Irrigation Scheduling - application.

Unit IV	NEURAL NETWORKS	9

Neuron, Nerve structure and synapse, Artificial Neuron and its model, Neural network architecture: networks, Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory- Architecture: model, solution, single layer and multilayer perception model; back propagation learning methods, applications.

Unit V	FUZZY LOGIC AND GENETIC ALGORITHM	9

Basic concepts of fuzzy logic, Fuzzy set theory and operations, Properties of fuzzy sets, Membership functions, interference in fuzzy logic, Fuzzy implications and Fuzzy algorithms, Fuzzy Controller, Industrial applications. Genetic Algorithm (GA) - Basic concepts, working principle, procedures, flow chart, Genetic representations, encoding, Initialization and selection, Genetic operators, Mutation – applications .

REFERENCE(S):

1. Chaturvedi, M.C., —Water Resources Systems Planning and Managementǁ, Tata McGraw Hill, New Delhi, 1997.
2. Taha, H.A., —Operations Researchǁ, McMillan Publication Co., New York, 1995.
3. Hiller, F.S., and Liebermann, G.J., —Operations Researchǁ, CBS Publications and distributions, New Delhi, 1992.
4. Timothy J. Ross, —Fuzzy Logic with Engineering Applicationsǁ Wiley India.
5. S. Rajsekaran & G.A. Vijayalakshmi Pai, —Neural Networks,Fuzzy Logic and Genetic Algorithm: Synthesis and Applicationsǁ Prentice Hall of India.

TEXT BOOK(S):

1. Vedula, S., and Majumdar, P.P. Water Resources Systems – Modeling Techniques and Analysis Tata McGraw Hill, New Delhi, Fifth reprint, 2010.

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2.	Robert M Peart and W David Shoup, Agricultural Systems Management – Optimizing efficiency and performance, CRC Press, 2013.
3.	Gupta, P.K., and Man Mohan, —Problems in Operations Researchll, (Methods and Solutions), Sultan Chand and Sons, New Delhi, 1995.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX02	IOT IN AGRICULTURAL SYSTEMS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is :

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models.

Course Outcomes: At the end of this course, learners will be:

- Able to understand the IT applications in environmental control systems, precision farming, agricultural systems management and weather prediction models.

Unit I	BASIC ELECTRONICS CIRCUITS	9

Passive devices -semi conductor devices - transistors - diode circuits - amplifier circuits- oscillator circuits-thyristor circuits-Integrated circuits and operational amplifier - logic gates - flip flop - counters digital to analog - analog to digital converters microprocessor introduction

Unit II	PRECISION FARMING	9

Precision agriculture and agricultural management-Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

Unit III	ENVIRONMENT CONTROL SYSTEM	9

Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture. Understanding and predicting world's climate system

Unit IV	AGRICULTURAL SYSTEMS MANAGEMENT	9

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

Unit V	E-GOVERNANCE IN AGRICULTURAL SYSTEMS	9

Concept of Information Technology (IT) and its application potential. Role of IT in natural resources management. Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society. Internet application tools and web technology.

REFERENCE(S):

1. Hammer, G.L., Nicholls, N., and Mitchell, C., Applications of Seasonal Climate, Springer, Germany, 20
2. Peart, R.M., and Shoup, W. D., Agricultural Systems Management, Marcel Dekker, New York, 2004.
3. National Research Council, Precision Agriculture in the 21st Century, National Academies Press, Canada, 1997.
4. H. Krug, Liebig, H.P. International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation, 1989.

TEXT BOOK(S):

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX03	CLIMATE CHNAGE AND ADOPTION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Know the basics, importance of global warming
- Know the concept of mitigation measures against global warming
- Learn about the global warming and climate change

Course Outcomes: At the end of this course, learners will be able to

- Demonstrate an understanding of how the threats and opportunities of predicted climate changes will influence specific sectors at global and regional scal
- Identify the relationship between atmosphere and its components
- Analyze the impacts of climate change on environment parameters
- Evaluate the scientific insights underlying the assessment reports of the IPCC, with a focus on impacts, adaptation and mitigation
- Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts

Unit I	EARTHS CLIMATE SYSTEM	9

Role of ozone in environment ozone layer ozone depleting gases Green House Effect, Radiative effects of Greenhouses Gases Hydrological Cycle Green House Gases and Global Warming Carbon Cycle.

Unit II	ATMOSPHERE AND ITS COMPONENTS	9

Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere- Composition of the atmosphere Atmospheric stability- Temperature profile of the atmosphere - Lapse rates - Temperature inversion - effects of inversion on pollution dispersion.

Unit III	IMPACTS OF CLIMATE CHANGE	9

Causes of Climate change : Change of Temperature in the environment Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem Water Resources Human Health Industry, Settlement and Society Methods and Scenarious Projected Impacts for Different Regions Uncertainties in the Projected Impacts of Climate Change Risk of Irreversible Changes..

Unit IV	OBSERVED CHANGES AND ITS CAUSES	9

Climate change and Carbon credits - CDM - Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCCIPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India.

Unit V	CLIMATE CHANGE AND MITIGATION MEASURES	9

Clean Development Mechanism -Carbon Trading -examples of future Clean Technology - Biodiesel - Natural Compost - Eco-Friendly Plastic - Alternate Energy -Hydrogen - Bio-fuels - Solar Energy - Wind - Hydroelectric Power -Mitigation Efforts in India and Adaptation funding Key Mitigation Technologies and Practices-Energy Supply - Transport - Buildings- Industry-Agriculture - Forestry - Carbon sequestration-Carbon capture and storage (CCS) - Municipal solid Waste (MSW) & Bio waste, Biomedical, Industrial waste International and Regional cooperation.

REFERENCE(S):

1. Adaptation and mitigation of climate Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006
2. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006

TEXT BOOK(S):

1. Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes?, Cambridge University Press, 2003

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Department	AGRICULTURE ENGINEERING					R 2019	Semester V	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX04	AGRICULTURAL BUSINESS MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is

- To study about the concept and importance of agri business system
- To develop the management competencies required by student in the field of Agriculture to establish and support profitable agribusiness in a competitive global business environment
- The ability to use effectively business management techniques in an international environment

Course Outcomes: At the end of this course, learners will able to

- Analyses agribusiness situations, formulate strategies, implement plans and manage strategic change
- Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment
- Analyze the process of management's four functions: planning, organizing, leading, and controlling
- Analyze the various structure and technologies of the agribusiness sector to develop the business in the competitive marketing
- Understand the systematic process to elect and ability to discern distinct entrepreneurial traits

Unit I	AGRIBUSINESS MANAGEMENT	9

Concept - components of agribusiness - forms of agribusiness firms. Management - concept - functions of management - managerial roles and skill (Mintzbergs) required at various levels of management.

Unit II	MANAGEMENT FUNCTIONS	9

Planning - steps and types of plans. Organizing - basis for Departmentation - Staffing - human resource planning process - Directing - techniques of direction. Coordination and control - types.

Unit III	FUNCTIONAL AREA - I	9

Operations management - planning and scheduling - supply chain management in agribusiness - Human resource management - job analysis, recruitment and selection process

Unit IV	FUNCTIONAL AREA - II	9

Marketing Management - market segmentation, consumer buying behavior and marketing mix - Financial management - concept and financial planning for agribusinesses

Unit V	ENTREPRENEURSHIP	9

Entrepreneur - entrepreneurship - types, characteristics and process - Innovation, business incubation and financing entrepreneurs.

REFERENCE(S):

1. Chandra Prasanna, "Projects: Preparation, Appraisal, Budgeting and Implementation", Tata McGraw Hill Publications, New Delhi, 2001.
2. Kotler, P., "Marketing Management. Analysis, Planning and Control", Prentice Hall Inc., New York, 2001.
3. Rao, V.S.P., and Narayana, P.S., "Principles and Practices of Management", Konark Publishing Private Limited, New Delhi, 2001.
4. Tripathy, P.C., and Reddy, P.N., "Principles of Management", Tata McGraw Hill Publications, New Delhi, 2000.

TEXT BOOK(S):

1. Himanshu, "Agri Business Management – Problems and prospects", Ritu Publications, Jaipur, 2005.
2. Smita Diwase, "Indian Agriculture and Agribusiness Management", Krishi resource Management Network, Pune 2004.

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX05	AGRICULTURAL ECONOMICS AND FARM MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is

- To impart the fundamental knowledge and basic concepts of Economics and Farm
- Management
- To understand the types of resources and Investment analysis in agriculture sector
- Farm financial analysis, Investment and Budgeting for farms

Course Outcomes: At the end of this course, learners will be:

- Able to plan the financial aspects related to farm management in a cost effective manner.

Unit I	FARM MANAGEMENT	9

Agricultural Economics – definition and scope – Farm Management – definition – scope- Classification of farms – Basic concepts in farm management - Relationship between farm management and other basic sciences - Farm layout – Farm records and accounts – Farm appraisal techniques – Valuation .

Unit II	LAWS OF ECONOMICS	9

Basic laws of economics – demand and supply concepts – law of increasing, diminishing and constant returns – Equi-marginal returns - Product relationship – Production function – definition and types – Production function curves – Optimum level of input use – Economies of scale external and internal economies and diseconomies - Cost concepts – types - Opportunity cost – comparison of costs – Factor relationship – concepts.

Unit III	COST CURVES	9

Principle of substitution – isoquant, isocline, expansion path, ridge line and least cost combination of inputs-Product-product relationship – Production possibility curve, isorevenue line and optimum combination of outputs – Cost curves –Optimum input and output levels – Factor –factor relationship – Least cost combination of inputs – Estimation of cost of cultivation and cost of production of crops - annual and perennial crops – Preparation of interview schedule and farm visit for data collection.

Unit IV	MANAGEMENT OF RESOURCES	9

Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks in production process – Management of resources – types of resources- land, labour, capital and measurement of their efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis – Investment analysis – Discounting techniques.

Unit V	FARM MANAGEMENT AND FINANCIAL ANALYSIS	9

Farm management- need and analysis – Farm financial analysis – Balance sheet – Income statement – Cash flow analysis – Farm investment analysis – Time comparison principles – Farm planning – Elements of farm planning – Whole farm planning and partial planning – Farm level management system – Farm budgeting – whole farm budgeting and partial budgeting – Estimation of credit - examples of farm planning and budgeting.

REFERENCE(S):

1. Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
2. Subba Reddy, S., and Raghu Ram, P. „ "Agricultural Finance and Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.
3. Sankhayan, P.L. „"Introduction to Farm Management", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001
4. Muniraj, R., "Farm Finance for Development", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2000.

TEXT BOOK(S):

1. Johl, S.S., and Kapur, T.R.,Fundamentals of Farm Business Management", Kalyani publishers, Ludhiana, 2007.

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2.	Subba Reddy, S., Raghu Ram, P., Neelakanta Sastry T.V and Bhavani
3.	Devi, I., "Agricultural Economics"Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX06	AGRICULTURAL EXTENSION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Expose the students to different extension methods for communication to take the workfrom lab to field

Course Outcomes: At the end of this course, learners will be:

- Familiar with various extensionmethods, communication gadgets. Be trained in capacity building techniques

Unit I	COMMUNICATION AND PROGRAMME PLANNING	9

Communication – meaning – definition – models – elements and their characteristics – types and barriers in communication. Programme planning – meaning, definition, principles, steps in programme development process, monitoring and evaluation of extension programmes.

Unit II	EXTENSION TEACHING METHODS	9

Extension teaching methods - Audio-Visual aids – definition – classification – purpose, planning and selection, combination and use – individual, group and mass contact methods – merits and demerits.

Unit III	MODERN COMMUNICATION GADGETS	9

Modern communication sources – internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kissan Call Centre (KCC), mobile phone

Unit IV	DIFFUSION AND ADOPTION	9

Diffusion – meaning and elements. Adoption – meaning – adopter categories and factors influencing adoption, stages of adoption, Innovation decision process and attributes of innovation consequences of adoption.

Unit V	CAPACITY BUILDING	9

Capacity building of extension personnel and farmers – meaning – definition, types of training, training to farmers, farm women and rural youth, FTC & KVK.

REFERENCE(S):

1. Rogers, E.M. 1995. Diffusion of Innovations, The Free Press, Newyork
2. Sandhu, A.S. 1996. Agricultural Communication: Process and Methods, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

TEXT BOOK(S):

1. Ray, G.L., 1999. Extension Communication and Management, Naya Prokash, 206, Bidhan Sarani, Calcutta.
2. Sandhu, A.S. 1996. Extension Programme Planning, Oxford & IBH Publishing Co. pvt. Ltd, New Delhi

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX07	REMOTE SENSING AND GIS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Introduce the students to the basic concepts and principles of various components of remote sensing
- Study the applications of Remote Sensing and GIS in agriculture, soil and water resources
- Understand in-depth the knowledge on the theory, methods, and equipment for the various unit operations of crop processing

Course Outcomes: At the end of this course, learners will be:

- Identify different electromagnetic radiations and evaluate its applications in remote sensing systems and satellite data processing satellite data processing
- Make use of platform and sensors and compare its applicability in available data products
- Analyze the Geographic Information System (GIS) images and categorize according to its application
- Identify components of Geographic Information System (GIS) and select suitable data base management systems (DBMS) and modeling tool
- Decide on RS &GIS tools to create a strategy on natural resource management.

Unit I	EMR AND ITS INTERACTION WITH ATMOSPHERE	9

Definition of remote sensing and its components -Electromagnetic spectrum - wavelength regions important to remote sensing - Wave theory, Particle theory, Stefan-Boltzman and Wein Displacement Law -Atmospheric scattering, absorption - Atmospheric windows - spectral signature concepts - typical spectral reflective characteristics of water, vegetation and soil.

Unit II	PLATFORMS AND SENSORS	9

Types of platforms - orbit types, Sun-synchronous and Geosynchronous - Passive and Active sensors resolution concept - Pay load description of important Earth Resources and Meteorological satellites-Airborne and space borne TIR and microwave sensors.

Unit III	IMAGE INTERPRETATION AND ANALYSIS	9

Types of Data Products - types of image interpretation - basic elements of image interpretation -visual interpretation keys - Digital Image Processing - Pre processing - image enhancement techniques - multispectral image classification - Supervised and unsupervised.

Unit IV	GEOGRAPHIC INFORMATION SYSTEM	9

Introduction Maps Definitions Map projections types of map projections map analysis GIS definition basic components of GIS standard GIS softwares Data type Spatial and nonspatial (attribute) data measurement scales Data Base Management Systems (DBMS) Modelling in GIS Digital Elevation Modelling

Unit V	RS AND GIS APPLICATIONS	9

Crop Acreage estimation - Estimation of Crop Water Requirement Crop condition - Soil mapping classification of soil with digital numbers soil erosion mapping- reservoir sedimentation using image processing - Inventory of water resources water quality assessment - Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health - Management Decision Support Systems

REFERENCE(S):

1. Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.
2. P.A. Burrough, Principle of GIS for land resources assessment, Oxford Publications, 1990.
3. Ian Heywood, an Introduction to GIS, Pearson Education, New Delhi, 2001
4. Floyd F.Sabins, Remote Sensing: Principles and Interpretation, III edition, Freeman and Company, New York, 1997
5. M.Anji Reddy, Textbook of Remote Sensing and Geographical Information System, 3rd Edition, BS Publications, 2008

TEXT BOOK(S):

1. Bettinger, P., and Michael, G.W., "Geographical Information System: Applications in Forestry and Natural Resources Management," Tata McGraw–Hill Higher Education, New

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	Delhi, 2003
2.	Jeffery Star and John Estes, "Geographical Information System – An Introduction," Prentice Hall India Pvt. Ltd., New Delhi, 1998.

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Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX08	AGRICULTURAL WASTE MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Give an idea about IPR, registration and its enforcement.

Course Outcomes: At the end of this course, learners will be:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

Unit I	INTRODUCTION	9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR..

Unit II	REGISTRATION OF IPRs	10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

Unit III	AGREEMENTS AND LEGISLATIONS	10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

Unit IV	DIGITAL PRODUCTS AND LAW	9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

Unit V	ENFORCEMENT OF IPRs	7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

REFERENCE(S):

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

TEXT BOOK(S):

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India Pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX09	SUSTAINABLE AGRICULTURE AND FOOD SECURITY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is

- To understand the concept of land resources and land degradation
- To understand the concept of water resources and utilizable water in future
- To get knowledge on sustainable agriculture and its components
- To acquire knowledge on trends in food production
- To understand the concept of policies of Natural Resources Use and sustainable livelihood

Course Outcomes: At the end of this course, learners will be:

- Able to determine land utilization and cropping pattern in India
- Able to estimate rainfall, drought and irrigation potential in watershed
- Able to execute natural farming principle for sustainable agriculture
- Able to estimate the food supply and demand projections
- Able to execute the policies for food security.

Unit I	LAND RESOURCE AND ITS SUSTAINABILITY	9

Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation.

Unit II	WATER RESOURCE AND ITS SUSTAINABILITY	9

Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Ground water & Surface water).

Unit III	SUSTAINABLE AGRICULTURE & ORGANIC FARMING	9

Agro-ecosystems - Impact of climate change on Agriculture, Effect on crop yield, effect on Soil fertility – Food grain production at State Level – Indicators of Sustainable food availability – Indicators of food production sustenance – Natural farming principles – Sustainability in rainfed farming – organic farming – principles and practices

Unit IV	FOOD PRODUCTION AND FOOD SECURITY	9

Performance of Major Food Crops over the past decades – trends in food production – Decline in total factor productivity growth – Demand and supply projections – Impact of market force – Rural Land Market – Emerging Water market – Vertical farming - Sustainable food security indicators and index – Indicator of sustainability of food Security – Path to sustainable development.

Unit V	POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY	9

Food and Crop Production polices – Agricultural credit Policy – Crop insurance –Policies of Natural Resources Use – Policies for sustainable Livelihoods – Virtual water and trade - Sustainable food Security Action Plan.

REFERENCE(S):

1. Swarna S.Vepa et al., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999.
3. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
4. M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.

TEXT BOOK(S):

1. B.K.Desai and Pujari, B.T. Sustainable Agriculture : A vision for future, New India Publishing Agency, New Delhi, 2007.
2. Saroja Raman, Agricultural Sustainability – Principles, Processes and Prospects, CRC Press, 2013.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX10	ERGONOMICS AND SAFETY IN AGRICULTURAL ENGINEERING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Study the physical work load, equipment/work place design, safety and occupational health hazards in farm operations.

Course Outcomes: At the end of this course,

- The student will gain knowledge to improve the performance of the farm systems by improving the human - machine interaction with safety measures.

Unit I	ERGONOMICS	9

Ergonomics- introduction- Role of ergonomics in Agriculture - Human metabolism- energy liberation in human body- Types of human metaboism- energy requirements at work - acceptable work load.

Unit II	PHYSIOLOGICAL FUNCTIONS	9

Human Skeletal system – muscle, structure and function - Physiological stress - Efficiency of work - Physical functions - Age and individual differences in physical functions- Physiological and operational criteria of physical activity.

Unit III	ENERGY EXPENDITURE	9

Energy expenditure of activities-keeping energy expenditure within bounds- Energy expenditure of Spraying-Weeding operations - Movements of body members- Strength and endurance of movements - Movement of body members related to Agricultural activities - Speed and accuracy of movements - Time and distance of movements - Reaction time.

Unit IV	ANTHROPOMETRY	9

Anthropometry – introduction- Types of data- Principles of applied anthrophometry - concept of percentile – Normal distribution – Estimating the range – Minimum and Maximum dimensions- Cost benefit analysis - applications of anthropometric data. Anthropometric consideration in tool / equipment design.

Unit V	HUMAN ENGINEERING IN TRACTOR DESIGN	9

The operator – Machine Interface – Operator exposure to environmental factors – Thermal comport for tractor operator – Spatial, Visual and Control requirement of the operator – Occupational health hazards - Noise – Dust- Vibration in Tractor.

BOOK(S):

1. Bridger, R.S. Introduction to ergonomics, McGraw Hill, INC, New York. 1995.
2. Sharma, D.N and Mukesh, S. Design of Agricultural Tractor- Principles and Problems, Jain Brothers, New Delhi. 2012.
3. Hand Book of Agricultural Engineering, Indian Council of Agricultural Research, New Delhi. 2013. (ISBN : 978-81-7164-134-5)

REFERENCE(S):

1. Wesley E.Woodson. Human Factors design Hand Book. McGraw Hill Book Co., New York. 1981.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PC
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX11	PROTECTED CULTIVATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on the protected cultivation of vegetables, fruits and flower crops.
- Sensitize the students on hi-tech production technology of fruits and vegetables and flower crops.
- Learn and practices the various production practices of flower and other high value crops

Course Outcomes: At the end of this course, learners will be able to:

- Describe the different methods of protected cultivation practices available for vegetable crops and flowers
- Assess the technology available for vegetable crops
- Assess the technology available for flower crops
- Assess precision farming techniques using sensors and Geographic information systems for the crops
- Assess the technology available for horticulture crops

Unit I	PROTECTED CULTIVATION AND ITS TYPES	9

Importance and methods of protected culture in horticultural crops. Importance and scope of protected cultivation, different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house. Study of environmental factors influencing green house production, cladding / glazing / covering material, ventilation systems, cultivation systems including nutrient film technique / hydroponics / aeroponic culture, growing media and nutrients, canopy management, micro irrigation and fertigation systems.

Unit II	PROTECTED CULTIVATION OF VEGETABLE CROPS	9

Protected cultivation technology for vegetable crops: Hi-tech protected cultivation techniques for tomato, capsicum nursery, cucumber, gherkins strawberry and melons, integrated pest and disease management, post harvest handling.

Unit III	PROTECTED CULTIVATION OF FLOWER CROPS	9

Protected cultivation technology for flower crops: Hi-tech protected cultivation of cut roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut foliages and fillers, integrated pest and disease management, postharvest handling.

Unit IV	PRECISION FARMING TECHNIQUES	9

Concept and introduction of precision horticulture: importance, definition, principles and concepts. Role of GIS and GPS. Mobile mapping system and its application in precision farming. Design, layout and installation of drip and fertigation in horticultural crops, role of commuters in developing comprehensive systems needed in site specific management (SSM), georeferencing and photometric correction. Sensors for information gathering, geostatistics, robotics in horticulture, postharvest process management (PPM), remote sensing, information and data management and crop growth models, GIS based modeling

Unit V	PRECISION FARMING OF HORTICULTURAL CROPS	9

Precision farming techniques for horticultural crops: Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

REFERENCE(S):

1. Lyn. Malone, Anita M. Palmer, Christine L. Vloghat Jach Dangeermond. Mapping out world: GIS lessons for Education, ESRI press, 2002
2. David Reed, Water, media and nutrition for green house crops. Ball publishing USA, 1996
3. Adams, C.R. K.M. Bandford and M.P. Early, Principles of Horticulture, CBS publishers and distributors, Darya ganj, New Delhi, 1996

TEXT BOOK(S):

1. H.Panda, Essential oils – Handbook, National Institute of Industrial Research, ISBN, New Delhi, 2000.

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2.	Anonymous, Handbook of oils, fats and derivatives with refining and packaging technology, Engineers India Research Institute, New Delhi, 2004.
3.	T.P. Hilditch, Industrial chemistry of the fats and waxes, Bailliere, Tindall and Co Publishers, London, 1943.

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Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX13	MECHNANICS OF TILLAGE AND TRACTION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the basic concept of tillage
- Gain knowledge on principles of dynamics of tillage
- Understand the basic concept of traction
- Understand the details of tyres
- Understand the concept of GIS application in soil dynamics

Course Outcomes: At the end of this course, learners will able to

- Determine soil properties, stress strain relationship with tillage tools
- Design tillage tools
- Apply techniques for effective ploughing
- Test tyres and select proper tyre for effective traction
- Apply GIS techniques for effective land preparation

Unit I	MECHANICS OF TILLAGE	9

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

Unit II	DYNAMICS OF TILLAGE	9

Design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics performance of tillage tools.

Unit III	TRACTION	9

Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction

Unit IV	TYRES	9

Tyre size, tyre lug geometry and their effects, tyre testing

Unit V	APPLICATIONS	9

Soil compaction and plant growth, variability and geo statistics, application of GIS in soil dynamics.

BOOK(S):

1. Klenin, N.L.; Popov, I.F. and V.A. Sakum, (1985). Agricultural machines. Amerind Pub. Co. NewYork
2. J. B. Liljedahl, P. K. Turnquist, D. W. Smith, & M. Hoki , 1996. Tractors and their power units. Fourth ed. American Society of Agricultural Engineers, ASAE .
3. Kepner, R. A., Roy Bainer and E. L. Barger. 1978. Principles of farm machinery. Third edition; AVI Publishing Company Inc: Westport, Connecticut.

REFERENCE(S):

1. Ralph Alcock.1986. Tractor Implements System. AVI Publ.
2. S. C. Jain, Farm Machinery- An Approach

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX14	LAND SCAPING	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand the Fundamentals of land scaping process.
- Develop skills in LS & Application of the techniques to large scale development
- Reclamation & restoration of derelict areas conservation and preservation of fragile and eco sensitive areas

Course Outcomes: At the end of this course, the learners will

- Equipped with landscape assessment techniques to deal with landscape planning for large scale projects.
- Apply principles learned through case studies of reclamation,restoration and conservation of fragile areas.

Unit I	LAND SCAPE	9

Fundamentals of landscape- land scaping processes – growth of and scaping – land scapecommunities – limiting factors – inertia and resilience.

Unit II	LANDSCAPE PLANNING & DEVELOPMENTAL PROJECTS	9

Impact of human activities – Introduction to EIA – Application of the techniques to large scale developments

Unit III	LANDSCAPE PLANNING AND RECREATION	9

National parks – protective designations – bio-diversity –biosphere reserves – concepts of eco-tourism – sustainable tourism.

Unit IV	LANDSCAPE ASSESSMENT TECHNIQUES	9

Basic quantitative methods of collecting, analyzing – projecting and presenting data – landscape planning – visual assessment – aesthetic dimension

Unit V	LANDSCAPE CONSERVATION	9

Reclamation – restoration of derelict areas – conservation and preservation of fragile and eco-sensitive areas – case studies..

BOOK(S):

1. Ervin H. Zube, Robert O Brush, Julios G.Y.Fabos, Landscape assessment values, perceptions, 1975.
2. G. Tyler Miller Jr., Living in the Environment: Principles, Connections, and Solutions, Brooks / Cole Publishers co., 2004.

REFERENCE(S):

1. Richard T.T.Forman & Michel Godron , Landscape Ecology, John Wiley & Sons; 1986
2. Tom Turner, Landscape Planning and Environmental Impact Design, UCL Press, London, 1998.
3. William M. Marsh, Landscape planning – Environmental Application, John Wiley and sons Inc., 1997.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VI	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX15	DESIGN OF FARM MACHINERY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Learn design considerations and their applications in agricultural tractors and typical machines
- Understand the standards and procedures for designing of primary and secondary tillage• implements
- Understand the standards and procedures for calibration of seed drill, planter and tractor safety measures

Course Outcomes: At the end of this course,

- Predict the knowledge on design considerations of farm machinery
- Asses the knowledge on design and construction of primary tillage implements
- Carryout the design and construction of secondary tillage implements
- Recognize the working principles of seed drill and planters
- Compute the knowledge on tractor safety measures.

Unit I	INTRODUCTION	9

Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems. Design considerations, procedure and their applications in agricultural tractors & typical machines. Reliability criteria in design and its application

Unit II	CONSTRUCTION OF PRIMARY TILLAGE IMPLEMENTS	9

Design of coulters, shares, mould boards. Construction of mould board working surface. Design of landside, frog, jointer. Forces acting on plough bottom and their effect on plough balance, trailed, semi mounted and mounted plough. Draft on ploughs, resistance during ploughing. Design disk ploughs, concave disk working tools, forces acting on disc ploughs.

Unit III	CONSTRUCTION OF SECONDARY TILLAGE IMPLEMENTS	9

Machines and implements for surface and inter row tillage, peg toothed harrow, disk harrows, rotary hoes, graders, rollers, cultivators, design of V shaped sweeps, rigidity of working tools. Rotary machines, trajectory of motion of rotary tiller tynes, forces acting, power requirement. Machines with working tools executing an oscillatory motion.

Unit IV	CALIBRATION OF SEED DRILL/PLANTER	9

Methods of sowing and planting, machines, agronomic specifications. Sowing inter-tilled crop. Grain hoppers, seed metering mechanism, furrow openers and seed tubes. Planting and transplanting, paddy transplanters, potato planters. Machines for fertilizer application, discs type broadcasters. Organic fertilizer application, properties of organic manure, spreading machines. Liquid fertilizer distributors

Unit V	TRACTOR SAFETY MEASURES	9

Safety devices for tractors & farm implements. Cabs & HVAC designs- designs of ROPS & FOPS, seat belts and helmets. Safety locations of PTO, belt pulley and hitch linkages and shield - safe tractor operation- maintenance inspection for safety.

BOOK(S):

1. Design of power screws, Lubrication theory, Static and Dynamic loadings.

REFERENCE(S):

1. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2010
2. Faculty of Mechanical Engineering, PSG College of Technology, Design Data Book, M/s.Kalaikathir Achchagam, 2013
3. J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2011
4. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, John Wiley & Sons, New Delhi, 2011
5. R. L. Norton, Design of Machinery, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2004

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX16	REFRIGERATION AND AIR CONDITIONING FOR AGRICULTURAL ENGINEERS	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Interpret principles of operation of different Refrigeration & Air conditioning systems
- Understand the types of compressors and expansion devices and their applications
- Combine the parameters involved in design of the various air conditioning systems

Course Outcomes: At the end of this course, learners will be:

- Elucidate the principles and practice of thermal comfort
- Analyse the vapor compression and heat-driven refrigeration systems
- Apply the knowledge on psychometric chart for designing heating and refrigeration units
- Identify various types of air conditioning systems and their application in food industry
- Evaluate applications and make design calculations of Heating, Ventilation and Air conditioning systems

Unit I	REFRIGERATION PRINCIPLES AND COMPONENTS	9

Refrigeration principles - refrigeration effect coefficient of performance -units of refrigeration - Refrigeration components -compressor-classification-principle and working- condensers-typesconstruction, principle and working. Evaporators - types-principle and working. Expansion device types construction, principle and working. Refrigerants properties classification comparison and advantages chloroflouro carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants

Unit II	VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE	9

Simple vapour compression cycle - T-S diagram - p-h chart- vapour compression system-different types-vapour absorption cycle simple and practical vapour absorption system- advantages- ideal vapour absorption system- Electrolux refrigerator Lithium bromide refrigeration-construction and principles.

Unit III	APPLIED PSYCHROMETRY	9

Principle and properties of psychrometry, Representation of various psychometric processes on psychometric chart and their analysis, by-pass factor, sensible heat factor, room sensible heat factor, equipment sensible heat factor, grand sensible heat factor, apparatus dew point, ventilation and infiltration, energy efficiency ratio. Use of psychometric charts. Cooling and heating load calculations.

Unit IV	AIR CONDITIONING SYSTEM	9

Air conditioning systems-equipment used-classification-comfort and Industrial air conditioning system- winter, summer and year- round air conditioning system- unitary and central air conditioning system- application of refrigeration and air conditioning-domestic refrigerator and freezer refrigerated trucks- ice manufacture- cold storage-freeze drying.

Unit V	APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION	9

Cooling and heating load estimation, cold storage design, types of cooling plants for cold storage. Insulation properties and types of insulation material. Cold storage for milk, meat, fruits, vegetables, poultry and marine products. Refrigerated Transport, Handling and Distribution, Cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display.

REFERENCE(S):

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2008
2. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2009
3. Roy J. Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 2007
4. N. F Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2008

TEXT BOOK(S):

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1.	Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd., 2007
2.	J. B Hains, Automatic Control of Heating & Air conditioning, Tata McGraw Hill Publishing Company Private Limited, 2005

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX17	STORAGE AND PACKAGING TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Study about the different storage structures
- Learn about the different packaging materials and various methods of packaging to improve the shelf life of the products
- Understand the concepts of Controlled Atmosphere Storage and Modified Atmosphere Packaging
- Learn about the equipment used for packaging

Course Outcomes: At the end of this course, learners will be:

- Possess the knowledge on Storage environment and storage structures
- Recognize the importance of packaging and Acquaint with the equipment used for packaging apply
- Determine the principles of Controlled Atmosphere Storage and Modified Atmosphere Packaging
- Differentiate various canning systems and their application in food industry
- Apply the knowledge to choose suitable flexible packaging film and the sealing technique for rocessed foods

Unit I	STORAGE ENVIRONMENT AND STORAGE STRUCTURES	11

Storage losses in agricultural commodities. Physical properties of grain affecting storability- Factors of spoilage- fungi and mycotoxins- Treatments for enhancing shelf life- Fumigation Processes for bag storage piles. Rural storage structures- Bag Storage and its Design. Parameters and types of storage structure. Bulk Storage in silos and large Bins Construction of Silos, Problems of Silo storage, relative Costs of Silo and Bag Storage. Quality Changes and remedial measures of Grains during storages. Design considerations and heat load calculation of cold storage.

Unit II	INTRODUCTION TO PACKAGING	8

Introduction Protection of Food products major role and functions of food packaging Effect of environmental factors, mechanical forces and biological factors on food quality and shelf life. Estimating the shelf life requirement accelerated storage studies. Tests on packaging materials Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates

Unit III	CONTROLLED ATMOSPHERE STORAGE AND MODIFIED ATMOSPHERE PACKAGING	10

Introduction and concept of CA Storage Equipment for creating, maintaining and measuring controlled atmosphere - Biochemical aspects of CA storage - Static & Dynamic CA, FruitRipening, Hypobaric and Hyperbaric Storage. Effects of concentrations of compositional gases on Fruits and vegetables. MAP-Film & Coating types, Permeability, Gas Flushing, Perforation, Absorbents, Humidity, Temperature, Chilling Injury, Shrink wrapping, Vacuum Packing, Modified Interactive Packaging, Minimal Processing, Equilibrium Modified Atmosphere Packaging, Effect of scavengers

Unit IV	CANNING	10

Metal Cans and Glass Bottles as Packaging. Types of Metallic cans. Basics of Canning operations, Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles, advantages and problems, Bottle and jar closures, different types of caps and liners used. Can double seam can seam formation and defects, Metal caps for bottles and jars applications. Plastics used and their Specific applications - Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Polyvinylidene Chloride (PVDC ÃƒÂ¢?? Diofan, Ixan and Saran), Polyvinyl chloride, Copolymers their applications. Closing and sealing of Rigid plastic containers ÃƒÂ¢?? Seal types.

Unit V	FLEXIBLE FILMS PACKAGING	6

Formation of Films and pouches, Co-extruded films and Laminates applications. Filling and Sealing of pouches and flexible plastic containers, Pouch form fill seal machines: Rigid and Semi rigid plastic packaging. Fabrication methods Thermo forming, Blow moulding, Injection moulding, Extrusion Blow moulding applications. Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging - applications. Printing on packages, Bar codes, Nutrition labeling and legislative requirements.

REFERENCE(S):

1. Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall, 1992
2. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman), Oxford,

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	UK,1994
3.	Ruth H. Matthews: Pulses Ã¢?? Chemistry, Technology and Nutrition Mercel Dekker Inc., USA,1989
TEXT BOOK(S):	
1.	Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
2.	Donald Downing, Complete Course in Canning (3 Volumes) CTI Publications Inc, USA, 1996

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX18	SEED PROCESSING TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Acquire the knowledge on the various seed production and processing technologies
- Impart knowledge on seed testing and the methods
- Impart knowledge about seed certification, legislation and industries in India

Course Outcomes: At the end of this course, learners will be:

- Classify various technologies available in seed production
- Identify the seed processing techniques and identify various seed processing equipment
- Learn the different methods and procedure to test the seeds
- Gain the knowledge on certification and legislation in seed industries
- Recognize the growth of seed industry and their role in India

Unit I	SEED PRODUCTION TECHNOLOGY	9

General Principles: Genetic principles, Agronomic principles, seed morphology, shape, size, seed hardness, colour; Harvesting of seed crops. Nucleus and Breeders seed, method of maintenance of nucleus and Breeders seed in self, fertilized and cross, fertilized crops, Foundation and certified seed production; Seed production of cereals, pulse, oil seeds, fibre crops, forage crops, sugar crops and their hybrid verities; physiological and harvestable maturity of different kinds of seeds.

Unit II	SEED PROCESSING TECHNOLOGY	9

Preparing seed for processing, Seed moisture and drying, Air screen cleaner, shape and size separators, gravity separators, surface texture separators, affinity for liquid separators, colour separators, electrical conductivity separators; seed treatment; seed elevators, conveyors, safe seed storage, seed packaging and handling, seed bins, dust removal, seed blending, seed marketing and distribution; methods for assessment of seed quality.

Unit III	SEED TESTING	9

Sampling methods, Determination of seed density, Tolerances, hetrogenity, Purity, genuineness of variety. Moisture estimation, Germination, equipment, seed scarification, pre sowing treatment, seed priming, pelleting; Viability: Vigour and health.

Unit IV	SEED CERTIFICATION AND LEGISLATION	9

Objectives and concepts of seed certification, seed certification agencies, minimum seed certification standards for breeders seed, certified seed. Field and seed inspection, methods of inspection, post harvest inspection. Seed legislation loss

Unit V	SEED INDUSTRY IN INDIA AND THEIR ROLE IN AGRICULTURAL DEVELOPMENT	9

Development of Seed industries in India: overview, National seeds corporation, State seeds Development Corporation. Five year plans. Private seed industries.

REFERENCE(S):

1. J.F Harrington and J.E Douglas, Seed storage and packaging application, NSC, New Delhi, 1963.
2. J.E Douglas, Seed Production Mannual, National Seeds Corporation and Rockfeller Foundation, New Delhi, 1969.
3. J.E Douglas, Seed Certification Mannual, National seeds corporation, New Delhi, 1970

TEXT BOOK(S):

1. B.R Gregg, A.G. Law, S.S Virdi and J.S Balis Seed Processing, National seed corporation, New Delhi, 1990
2. R.L Agrawal, A text book on Seed Technology, Oxford & IBH Publication, Co Pvt Ltd, New Delhi-1992
3. L.O Copeland and M.B Mc Donald, Principles of Seed Science and Technology, Chapman and Hall, New York, 1995.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX21	SOIL AND WATER CONSERVATION ENGINEERING	3	0	2	4	66	100	

Course Objective (s): The purpose of learning this course is to

- Acquire the fundamental understanding of soil conservation practices and erosion control structures
- Develop skills on water conservation and harvesting
- Provide knowledge on watershed development and management

Course Outcomes: At the end of this course, learners will be:

- Identify the causes of soil erosion, types of soil erosion and assess the total soil loss for watershed
- Design the gully control structures for controlling the landslides
- Design the agronomic and mechanical measures for controlling soil erosion
- Classify the water harvesting structures for insitu and exsitu water conservation
- Prioritize and execute the watershed development programme with land capability classification for watershed management

Unit I	SOIL EROSION	12

Problems of soil erosion - Geological and Accelerated erosion, Factors affecting water erosion, Types of water erosion - Splash, sheet and rill, Gully, stream bank and road erosion and ravines, Universal Soil Loss Equation (USLE) & soil loss tolerance, Measurement of runoff and soil loss Ã¢??Runoff plot- Multislot divisor unit - Coshocton rotating wheel sampler -Sediment yield and sedimentation, Wind erosion mechanics - Methods of estimation of wind erosion - Desertification, deforestation and shifting cultivation.

Unit II	EROSION CONTROL	12

Erosion control measures, Contour bunds and Graded bunds, Broad beds and furrows, wide based terraces and dykes, Random tie ridging, basin listing and mulching, Bench terraces, stone walls and contour trenches, - Contour cultivation, strip cropping, mixed cropping, mixed farming, crop rotation for erosion control, Afforestation - Diversion drains and vegetative water ways,

Unit III	GULLY CONTROL STRUCTURES	10

Gully control and control of landslides, Temporary gully control measures, Permanent Gully Control Structures - Wind erosion control - wind breaks and shelter belts

Unit IV	WATERSHED MANAGEMENT	8

Watershed - concept - planning, Principles - Components of watershed development - Watershed management plan - Biological. Watershed management plan Engineering.

Unit V	WATER HARVESTING	8

Water harvesting methods, Farm pond - lined and unlined - Computation of capacity, Percolation pond - Selection of site - components, Dry farming techniques for improving crop production.

REFERENCE(S):

1. R. Suresh, Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi, 2000.
2. Ghanshyam Das, Hydrology and Soil Conservation Engineering Prentice-Hall of India Pvt Ltd., New Delhi, 2000
3. Glenn and O. Schwab, Soil and water Conservation Engineering, John Wiley and sons, New York, 1981.
4. B.C., Mal, Introduction to soil and water Conservation Engineering, Kalyani Publishers, New Delhi, 2002.
5. Gurmel Singh et al, Manual of soil and water conservation practices. Oxford & IBH Publishing Co, New Delhi, 1996.
6. A.M. Michael, and T.P. Ojha, Principles of Agricultural Engineering Vol II Jain Brothers, New Delhi, 1980

TEXT BOOK(S):

1. Applications-Basic agronomical measures-Grassland management-watershed development twasteland development-case studies.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours / Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX21	SOIL AND WATER CONSERVATION ENGINEERING	3	0	2	4	66	100	

Exp No.	Name of Experiments
1	Problems of soil erosion - Geological and Accelerated erosion, adverse effects of water and wind erosion. Factors affecting water erosion.
2	Universal Soil Loss Equation (USLE)
3	Soil erodibility Index - erodibility nature of soils. Slope, slope length and topographical factors
4	Measurement of runoff and soil loss
5	Wind erosion mechanics and factors affecting wind erosion.
6	Methods of estimation of wind erosion
7	Desertification, deforestation and shifting cultivation.
8	Types of erosion control measures

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX23	SPECIAL FARM EQUIPMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Impart knowledge on interculture equipment
- Study about types, parts and function of sprayers and dusters
- Gain knowledge on working principle of various harvesting equipments.
- Understand the construction and working of threshers and other machineries
- Understand the working principle of special farm equipment

Course Outcomes: At the end of this course, learners will able to

- Select and design interculture equipment
- Calculate the particle size and area covered by different sprayers
- Select suitable harvesting equipment
- Use fruit pluckers, tree shakers, post hole diggers and chaff cutter
- Operate special farm equipment

Unit I	MOWERS AND WEEDING EQUIPMENT	9

Weeding and intercultural equipment. Junior hoe - guntaka - blade harrow - rotary weeders for upland and low land - selection, constructional features and adjustments - Spading machine – coir pith applicators - Mower mechanism – lawn mowers.

Unit II	SPRAYERS AND DUSTERS	9

Sprayers – Sprayer operation – boom sprayer - precaution - coverage - factors affecting drift. Rotating disc sprayers – Controlled Droplet Application (CDA) - Electrostatic sprayers - Areal spraying – Air assist sprayers - orchard sprayers - Dusters - types - mist blower cum duster - other plant protection devices, care and maintenance.

Unit III	THRESHERS AND HARVESTERS	9

Construction and adjustments - registration and alignment. Windrowers, reapers, reaper binders and forage harvesters. Diggers for potato, groundnut and other tubers. Sugarcane harvesters - cotton pickers - corn harvesters - fruit crop harvesters – vegetable harvesters.

Unit IV	THRESHERS AND OTHER MACHINERIES	9

Thresher – construction and working of multi crop thresher. Forest machinery - shrub cutters - tree cutting machines – post hole diggers – Chaff cutter- flail mowers - lawn mowers – tree pruners.

Unit V	SPECIALIZED FARM EQUIPMENT	9

Pneumatic planters – air seeders – improved ploughs – reversible ploughs – suction traps – seed and fertilizer broadcasting devices, manure spreaders, sweep weeders – direct paddy seeders, direct paddy cum daincha seeder, coconut tree climbing devices, tractor operated hoist, tractor operated rhizome planter - Transplanters and Balers.

BOOK(S):

1. Jagdishwar Sahay. 2010. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.
2. Michael and Ojha. 2005. Principles of Agricultural Engineering. Jain brothers, New Delhi.

REFERENCE(S):

1. Kepner, R.A., et al. 1997. Principles of farm machinery. CBS Publishers and Distributers, Delhi.
2. Harris Pearson Smith et al. 1996. Farm machinery and equipments. Tata McGraw-Hill pub., New Delhi.
3. Srivastava, A.C. 1990. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX24	ON FARM WATER MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Acquire the knowledge on design of irrigation channels
- Gain the knowledge on command area development programme
- Acquire knowledge on surface and ground water resources
- Understand the concept of water balance
- Understand the concept of socio-economic prospective in farm water management

Course Outcomes: At the end of this course, the learners will able to

- Apply the Kennedy's and Lacey's theories to design the irrigation channels
- Describe water distributing system in command area
- Apply Markov chain method in rainfall analysis
- Calculate water use efficiency in field level
- Calculate water pricing in command area

Unit I	DESIGN OF IRRIGATION CHANNELS	9

Design of Erodible and Non-Erodible, Alluvial channels- Kennedy" s and Lacey" s Theories - Materials for Lining watercourses and field channel - Water control and Diversion structure - Design - Land grading - Land Leveling methods.

Unit II	COMMAND AREA	9

Command area - Concept – CADA Programmes in Tamil Nadu - Duty of water - expression - relationship between duty and delta - Warabandhi - water distribution and Rotational Irrigation System – case studies.

Unit III	CONJUNCTIVE USE OF SURFACE AND GROUNDWATER	9

Availability of water - Rainfall, canal supply and groundwater – Irrigation demand - water requirement and utilization - Prediction of over and under utilization of water – Dependable rainfall – Rainfall analysis by Markov chain method – Probability matrix.

Unit IV	WATER BALANCE	9

Groundwater balance model – Weekly water balance - Performance indicators – Adequacy, Dependability, Equity and efficiency – conjunctive use plan by optimization – Agricultural productivity indicators – Water use efficiency.

Unit V	SPECIAL TOPICS	9

National water policy - Institutional aspects - Socio-economic perspective- Reclamation of salt affected soils- Seepage loss in command area- Irrigation conflicts- Water productivity – Water pricing.

BOOK(S):

1. Michael, A.M. Irrigation Theory and practice, Vikas publishing house, New Delhi, 2006

REFERENCE(S):

1. Keller, .J. and Bliesner D.Ron, 2001 Sprinkler and Trickle irrigation, An ari book, Published by Van No strand Rein hold New York.
2. Israelson, 2002, Irrigation principles and practices, John Wiley & sons, New York.
3. Modi, P.N., 2002. Irrigation and water resources and water power engineering, Standard Book House, New Delhi.
4. Michael, A.M. and Ojha, T.P. 2002. Principles of Agricultural Engineering Vol II Jain Brothers, New Delhi.
5. Suresh, R. 2008. Land and water management principles, Standard Publishers & Distributors, New Delhi.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX25	FAT AND OIL TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- Understand about the physical and chemical properties of fats and oils
- Learn the extraction and refining processes of oils
- Learn about packaging, quality standards of fats and oils

Course Outcomes: At the end of this course, the learners will able to

- Explain various physical and chemical properties of fats and oils
- Possess the knowledge on different oil extraction processes
- Recognize the objectives of refining and various methods used for refining oils
- Apply the knowledge on packaging materials to select better packaging material for oils
- Determine the industrial applications of oils and different quality standards for oils

Unit I	PHYSICAL AND CHEMICAL PROPERTIES	10

Fats and oils - Physical and chemical properties - formation functions of oil in human body - fatty acids - double bonds and their position in oil Geneva type classification sources of vegetable oils production status-oil content coconut , palm, peanut , rice bran, sesame, mustard and sunflower seeds oil physical and chemical properties of fats and oils chemical reactions of oil hydrolysis hydrogenation, oxidation and polymerization.

Unit II	EXTRACTION METHODS	10

Oil extraction methods -mechanical expression - ghani , power ghani, rotary, hydraulic press, screw press, expellers, filter press - principle of operation and maintenance-solvent extraction process - steps involved, batch and continuous-continuous solvent extraction process for rice bran, soy bean and sunflower-oil extraction process for groundnut and cotton seed-production of special oils - palm oil, coconut oil - extraction process.

Unit III	REFINING OF OILS	10

Refining of oils - objectives - characterization - degumming - Zeneath process- deacidification process - continuous acid refining-bleaching of oil - continuous bleaching process - decolourising agents-deodorization process - winterization processes-hydrogenation of oil - selectivity - catalyst - batch type hydrogenation - regeneration of catalyst-vanaspathi, ghee and margarine - production process-partial sterilization, emulsification, chilling, kneading and rolling, incorporation of salt, colouring substances-production of special fats- butter - types - production and storage.

Unit IV	PACKAGING OF EDIBLE OILS	9

Packaging of edible oils - requirements types tin plate, semi rigid, glass, Polyethylene Terephthalate, Poly Vinyl Chloride, flexible pouches-packaging for vanaspati and ghee changes during storage of oil rancidity causes atmospheric oxidation and enzyme action free fatty acid - colour-non edible oils -castor oil, linseed oil, vegetable waxes - production and processing.

Unit V	INDUSTRIAL APPLICATIONS AND QUALITY STANDARDS	6

Industrial applications of fats and oils - quality regulations - manufacture of soap, candle, paints and varnishes - ISI and Agmark standards - site selection for oil extraction plant- safety aspects HACCP standards in oil industries.

BOOK(S):

1. Study of quality parameters of cooked oil.

REFERENCE(S):

1. Harry Lawson, Food oils and Fats, Technology, Utilization and Nutrition, CBS Publishers and Distributors, New Delhi, 1997
2. K.T. Acharia, Oil seeds and oil milling in India. Oxford and IBH publication, New Delhi, 1990.
3. H. Panda, Essential oils Ã¢?? Hand book, National Institute of Industrial Research, ISBN, New Delhi, 2000.
4. Anonymous, Handbook of oils, fats and derivatives with refining and packaging technology, Engineers India Research Institute, New Delhi, 2004

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5.	T.P. Hilditch, Industrial chemistry of the fats and waxes, Bailliere, Tindall and Cox Publishers, London, 1943.
6.	T.J. Weiss, Food Oils and their uses, The AVI Publishing Company, Inc. Westport, Connecticut, 1970.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VIII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX26	PROCESS ENGINEERING OF FRUITS AND VEGETABLES	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To understand the basics of Post Harvest Technology of fruits and vegetables through their structure and composition
- To study the different methods of processing and preservation of fruits and vegetables including drying and dehydration
- To learn the latest methods of storage of fruits and vegetables

Course Outcomes:

- At the end of this course, the student will be thorough in various methods of processing, preservation and storage of fruits and vegetables using latest technologies.

Unit I	STRUCTURE, COMPOSITION, RIPENING AND SPOILAGE	9

Importance of post harvest technology of horticultural crops – post harvest losses – factors causing losses - structure, cellular components, composition and nutritive value of horticultural crops – fruit ripening – mechanism and equipment - spoilage of perishable commodities – mechanism and factors causing spoilage.

Unit II	CLEANING, GRADING AND ON-FARM PROCESSING	9

Harvesting and washing of fruits and vegetables – cleaning and grading – fruits and vegetables - peeling - equipments – construction and working – pre-cooling – importance, methods, pretreatments and advantages.

Unit III	PRESERVATION OF FRUITS AND VEGETABLES	9

Thermal and non-thermal techniques of preservation of fruits and vegetables and their products - methods - minimal processing of horticultural commodities – fruits and vegetables, advantages - quick freezing preservation - commercial canning of fruits, vegetables and other perishable commodities – processing and concentration of juice - membrane separation process and application - hurdle technology of preservation and techniques.

Unit IV	DRYING AND DEHYDRATION	9

Dehydration of fruits and vegetables – types of dryers, construction and working - methods – fluidized bed dryer, freeze drying, osmotic dehydration and foam mat drying – principles, construction, operation and applications - quality parameters and advantages.

Unit V	STORAGE	9

Storage of fruits and vegetables – storage under ambient conditions, low temperature storage, evaporative cooling – cold storage of horticultural commodities – estimation of cooling load - controlled atmosphere storage – concept and methods –modified atmosphere packaging – gas composition, quality of storage – waxing of fruits – types of wax, equipment and advantages.

BOOK(S):

1. Fellows. P. 2000. Food Processing Technology – Principles and Practice, second edition, CRC Press, Woodland Publishing Limited, Cambridge, England.
2. Sudheer K. P. and V. Indra.2007. Post harvest Technology of Horticultural Crops. New India Publishing Company, New Delhi.
3. Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition, Cenage Learning India Private Ltd, 2012. L.R.Verma and V.K.Joshi. 2000. Post Harvest Technology of Fruits and Vegetables – handling, Processing, Fermentation and waste management. Indus Publishing company, New Delhi.

REFERENCE(S):

1. Heid,J.L. and M.A.Joslyn. 1983. Food processing operations. Vol. II. AVI Publishing Co.

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	Inc. Westport, Connecticut.
2.	Potter, N.N.1976. Food science. AVI Publishing Co. Inc.Westport, Connecticut, 2nd edition.
3.	Sivetz Michael and N.W.Desrosier. 1979. Coffee Technology. AVI Publishing Co. Inc, Westport, Connecticut.
4.	Frank.H.Slade. 1967. Food Processing Plant. Volume 1. Leonard Hill Books. London.
5.	SudhirGupta.Cold storage unit. Atif printers, LalKuan, Delhi.
6.	NIIR board. Modern techniques on food preservation. Asia pacific business press inc. Delhi
7.	Humberto vega and Gustavo v Barbosa. 1996. Dehydration of foods. Springer Science, Business Media, Chapman&Hall Publishers, U.K.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VIII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX27	WATERSHED MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To acquire the fundamental understanding of watershed planning and management
- To develop skills on water conservation and harvesting
- To prepare watershed development plans and cost estimate

Course Outcomes: At the end of this course,

- The students will able to describe the watershed management concepts
- The students will able to describe the components involved in watershed planning
- The students will able to describe the methods of water harvesting structures
- The students will able to design and construct the soil conservation structures
- The students will able to prioritize and execute the watershed development programme

Unit I	INTRODUCTION	9

Watershed Management concepts leading to control of quality and quantity of runoff, Geomorphology of watersheds. Problems and Prospects in Watershed Management. Land Capability and its Classification, Watershed Based Land Use Planning. Watershed Characteristics: Classification and Measurement, Importance of Watershed Properties for Watershed Management.

Unit II	HYDROLOGIC DATA FOR WATERSHED PLANNING	9

Importance of Watershed Planning, Utility of Hydrologic Data in Watershed Planning. Watershed Delineation, Prioritization of Watersheds. Water Yield, Measurement of Water Yield from Watersheds. Hydrologic and Hydraulic Design of Recharge Structures, Design of Earthen Embankments and Diversion Structure

Unit III	WATER MANAGEMENT	9

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

Unit IV	SOIL EROSION AND ITS CONTROL MEASURES	9

Problem /Types of Water Induced Soil Erosion & Measures for its Control, Problem/ Types of Wind Induced Soil Erosion & Measures for Control. Measurements of Sediment Yield, Estimation and Modeling of Sediment Yield. Rainwater Conservation Technologies, Design of Water Harvesting Structures. Watershed Land Use/Land Cover, Effect of Land Use Land Cover on Watershed Hydrology

Unit V	PROJECT PLANNING METHODS	9

Preparation of project plans. Preparation reports, Cost benefit analysis. Methodologies to encourage peoples participation

BOOK(S):

1. Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.
2. Ghanashyam Das, —Hydrology and Soil Conservation Engineering‖, Prentice Hall of India Private Limited, New Delhi, 2000.

REFERENCE(S):

1. All India Soil and Land Use Survey (AISLUS), Watershed Atlas of India, All India Soil and Land Use Survey, Ministry of Agriculture, Government of India, New Delhi, India, 1990
2. K.N.Brooks, P.F.Ffolliott and J.A.Magner, Hydrology and the management of watersheds, Fourth Edition, Wiley-Blackwell, 2013
3. United States Environmental Protection Agency (USEPA), Handbook for developing watershed plans to restore and protect our waters, USEPA, 2008
4. A.Agarwal, Drought, Try Capturing the Rain, Occasion paper, Centre for Science and Environment, New Delhi, 2000
5. Indian Journal of Arecanut, Spices & Medicinal Plan
6. A.S.Patel and D.L.Shah, Water Management, New Age International Publishers, 200

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VIII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX28	MICRO IRRIGATION	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To understand the basic concepts, tools, and skills used to deliver water efficiently and effectively on both a field and garden scale efficiency
- To learn about the role of irrigation water in agriculture, and the environmental factors that influence the type, frequency, and duration of irrigation
- To learn about the resources and essential skills needed to determine the proper timing and volume of irrigation, using both qualitative and quantitative methods

Course Outcomes: At the end of this course,

- Categorize the different types of pumps and water lifting devices based on the principle, components, and working efficiency
- Explain the working principle of centrifugal pump as well as its characteristics with efficiencies and design the centrifugal pump including impeller design, casing and other parts of pumps
- Estimate water budgets and hydraulics used to develop irrigation schedules through micro irrigation based on crop geometry
- Design drip and sprinkler irrigation system including, main line, sub main and laterals designs by consider pump capacity
- Design green house irrigation system and advanced types of irrigation including lift irrigation and
- automation

Unit I	TYPES OF PUMPS AND OTHER WATER LIFTING DEVICES	9

Indigenous water lifts, types and their working. Types of pumps: Positive displacement and variable displacement pumps. Reciprocating pump, principle, components, single acting and double acting, work done, coefficient of discharge, slip.

Unit II	CENTRIFUGAL, SUBMERSIBLE AND TURBINE PUMPS	9

Centrifugal pump: classification, principle and working, fundamental equations of centrifugal pumps, ideal, virtual and manometric heads of centrifugal pumps, net positive suction head, work done by centrifugal pump. Pump characteristics and efficiencies, priming and cavitation in centrifugal pumps, multistage centrifugal pumps. Design of impellers and casing, selection of centrifugal pumps. Submersible, Turbine pumps, Mixed flow, Axial flow, jet and Airlift pumps. Pump selection and installation, pump troubles and remedies

Unit III	WATER BUDGETING AND DRIP IRRIGATION	9

Micro irrigation: classification, Irrigation scheduling, Water Budgeting with micro irrigation. Hydraulics of micro irrigation, components. Valves, planning factors. Wetting pattern, crop geometries.

Unit IV	DRIP AND SPRINKLER IRRIGATION DESIGN	9

Sprinkler irrigation, components, performance. Uniformity and efficiency of sprinkler systems, sprinkler discharge. Distance of throw. Distribution pattern, application rate. Droplet size. Sprinkler selection and spacing, capacity of sprinkler system. Design of laterals, tapered. Design of Main lines, pump capacity. Operation and maintenance of sprinkler irrigation system

Unit V	SPECIAL TYPES OF IRRIGATION	9

Greenhouse irrigation system, design. Lift irrigation system: Design, subsurface drip irrigation. Soil less culture, Fertigation, Automation

BOOK(S):

1. Suresh, R., —Principles of Micro-Irrigation Engineeringll, Standard Publishers Distributors, New Delhi, 2010.
2. Michael, A.M. 2015. Second Edition. Irrigation: Theory and Practices, Vikas Publishing House Pvt., Limited.

REFERENCE(S):

1. V.Ravikumar and M.V.Ranghaswami, Micro irrigation and irrigation pumps. Kalyani Publishers, Ludhiana. 2011

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2.	Jack Keller and Rond Belisher, Sprinkler and Trickle irrigation, Van Nostrand Reinhold, New York, 1990
3.	I.J. Kavassik, Engineers Guide to Centrifugal pumps, McGraw Hill Book Company, 1964
4.	A.M.Michael, Irrigation theory and practice, Vikas publishers, New Delhi, 2010
5.	L.J. James, Farm Irrigation System Design, John Wiley & Sons, 1988

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VIII	PE
Course Code	Course Name	Hours/Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX29	POST HARVEST TECHNOLOGY	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- The students would be exposed to fundamental knowledge in engineering properties of agricultural materials, different Post Harvest operations and processing methods of

Course Outcomes: At the end of this course, learners will be:

- Material handling equipments
- Different Post Harvest operations and processing methods of harvested crops.
- Fundamentals of various unit operations of Agricultural Processing.

Unit I	FUNDAMENTALS OF POST HARVESTING	9

Post harvest technology – introduction –objectives –post harvest losses of cereals, pulses and oilseeds – importance - optimum stage of harvest. Threshing – traditional methods mechanical threshers – types-principles and operation-moisture content –measurement –direct and indirect methods – moisture meters – equilibrium moisture content..

Unit II	PSYCHROMETRY AND DRYING	9

Psychrometry – importance – Psychrometric charts and its uses – Drying – principles and theory of drying – thin layer and deep bed drying – Hot air drying – methods of producing hot air – Types of grain dryers – selection – construction, operation and maintenance of dryers – Design of dryers

Unit III	CLEANING AND GRADING	9

Principles - air screen cleaners – adjustments - cylinder separator - spiral separator – magnetic separator - colour sorter - inclined belt separator – length separators - effectiveness of separation and performance index.

Unit IV	SHELLING AND HANDLING	9

Principles and operation – maize sheller, husker sheller for maize – groundnut decorticator – castor sheller – material handling – belt conveyor –screw conveyor – chain conveyor – bucket elevators – pneumatic conveying.

Unit V	CROP PROCESSING	9

Paddy processing – parboiling of paddy – methods – merits and demerits – dehusking of paddy – methods – merits and demerits – rice polishers –types – constructional details – polishing –layout of modern rice mill - wheat milling – pulse milling methods – oil seed processing – millets processing..

REFERENCE(S):

1. Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994.
2. Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955.

TEXT BOOK(S):

1. Chakraverty, A.Post harvest technology for Cereals, Pulses and oilseeds. Oxford & IBH publication Pvt Ltd, New Delhi, Third Edition, 2000.
2. Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing. Vikas publishing house Pvt. Ltd., New Delhi, 1994.

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VIII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX31	ENERGY AUDITING AND MANAGEMENT	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To acquaint and equip the students in energy auditing in industries and house hold sectors for increasing energy efficiency.

Course Outcomes: At the end of this course,

- The students will acquire the knowledge on fundamentals of economic operation of an electrical system and understand the basic principles of energy auditing, types and objectives, instruments used.

Unit I	ENERGY CONSERVATION CONCEPTS	9

Energy – classification – scenario – energy pricing – energy and environment – energy conservation and its importance – energy strategy for the future – energy conservation act and its features.

Unit II	ENERGY AUDITING AND ECONOMICS	9

Objectives of energy management – principles – energy audit strategy - types – detailed energy audit –steps. Energy performance - bench marking – fuel substitutions – energy audit instruments – material and energy balance – energy conversion – energy index – cost index – financial management – financing options.

Unit III	THERMAL ENERGY AUDIT	9

Energy efficiency in thermal utilities – methodology – stoichiometric analysis of combustion in a boiler – performance evaluation – boiler losses - analysis – feed water treatment – energy conservation opportunities in boilers and steam system – furnaces – insulation and refractories – cogeneration – principles of operation - waste heat recovery systems – case study – analysis.

Unit IV	ELECTRICAL ENERGY AUDIT – I	9

Electrical systems – introduction – electricity billing – load management – power factor – improvements and benefits – transformers – distribution losses – analysis – energy audit in electrical utilities methodology – energy conservation opportunities in motors – efficiency – energy efficient motors – motor losses – analysis – energy efficiency in compressed air system

Unit V	ELECTRICAL ENERGY AUDIT - II	9

HVAC and refrigeration system – fans and blowers – fan performance – pumps - lighting system - energy auditing and reporting in industries – replacement of renewable energy technology option – case study in agro-industries

BOOK(S):

1. Guide books for National Certification Examination for Energy Managers and Energy Auditors, Book 1, 2, 3 & 4. Bureau Energy Efficiency, New Delhi. 2005.
2. Murphy, W.R. and McKay, G. Energy Management. Butterworth & Co., Publishers Ltd., London. 1982.
3. Craig B. Smith. Energy Management Principles, Applications, benefits & savings. Pergamon Press Inc. 1981.
4. Murgai, M.P. and Ram Chandra. Progress in Energy Auditing and Conservation - Boiler Operations, Wiley Eastern Ltd. 1990.

REFERENCE(S):

1. Victor B.Ottaviano,Energy Management. An OTIS Publication. Ottaviano Technical Service Inc. 150. Broad Hollow Road, Melville, New York. 11747.
2. Richard Porter and Tim Roberts, 1985. Energy saving by Waste recycling. Elsevier applied science publishers.
3. Energy Management - Bi-monthly journal published by National Productivity Council, New

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Department	AGRICULTURE ENGINEERING					R 2019	Semester VIII	PE
Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX32	AUTOMATION IN AGRICULTURE	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is

- To expose the students to the concept of Irrigation Automation
- To introduce the concepts of Automatic Systems and IoT applications
- To train the students to explore and use new technologies in Irrigation

Course Outcomes: At the end of this course,

- Student will understand the technologies available for automation
- Students can design conventional methods as automated system to be more efficient

Unit I	INTRODUCTION TO AUTOMATION	9

Automatic Irrigation – Traditional methods of Irrigation – Need for Automation – Comparison between Traditional and Automated Irrigation – Advantages – Disadvantages – Economic Impacts of Automation on Agricultural Firms – Future of Automation.

Unit II	SYSTEMS OF AUTOMATION	9

Automated Irrigation – Pneumatic System – Portable timer system – Timer/Sensor Hybrid/SCADA – Methods of automating Irrigation layout – Machine Learning in Tank Monitoring System.

Unit III	IoT IN IRRIGATION	9

IoT based Automated Irrigation System – IoT based Smart Irrigation – Sensor based Automation – types – operation – Solar based Automatic Irrigation System – components – operation - Automation by sensing soil moisture – Automation using ANN based controller – operation.

Unit IV	SURFACE AND MICRO-IRRIGATION AUTOMATION	9

Automation and control in Surface Irrigation Systems – Equipments – benefits – barriers – Automation Design in Bay, Basin and Furrow Irrigation – Automation in Micro Irrigation – Systems of Automation and its components – Design – Cost – Operation and maintenance.

Unit V	ASSESSMENT OF PARAMETERS IN IRRIGATION	9

Crop water estimate using Satellite data – Automation of Lysimeter for PET Measurements and Energy based Remote Sensing model – Remote Monitoring design of Automatic Irrigation system– Cost and Benefits of Automation.

BOOK(S):

1. H.R.Haise, E.G.Kruse. et al., 1981. "Automation of Surface Irrigation: 15 years of USDA Research and Development at Fort Collins, Colorado"

REFERENCE(S):

1. Brian Wahlin and Darell Zimbelman, Canal Automation for Irrigation Systems, American Society of Civil Engineers, 2014
2. Darell D.Zimbelman, Planning, Operation, Rehabilitation and Automation of Irrigation water delivery system, American Society of Agricultural Engineers,1987

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Course Code	Course Name	Hours/ Week			Credit	Total Hours	Maximum Marks	
		L	T	P	C			
19AGX33	FUNDAMENTALS OF NANO SCIENCE	3	0	0	3	45	100	

Course Objective (s): The purpose of learning this course is to

- To learn about basis of nanomaterial science, preparation method, types and application

Course Outcomes: At the end of this course,

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterials

Unit I	INTRODUCTION	9

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowiresultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

Unit II	GENERAL METHODS OF PREPARATION	9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

Unit III	NANOMATERIALS	9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arcgrowth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclaysfunctionalization
and applications-Quantum wires, Quantum dots-preparation, properties and applications.

Unit IV	CHARACTERIZATION TECHNIQUES	9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

Unit V	APPLICATIONS	9

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

BOOK(S):

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE(S):

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Department	AGRICULTURE ENGINEERING			R 2019	Semester VIII	PE
Course		Hours/	Credit	Total	Maximum	

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Code	Course Name	Week				Hours	Marks
		L	T	P	C		
19AGX34	BIO AND THERMO CHEMICAL CONVERSION OF BIOMASS	3	0	0	3	45	100

Course Objective (s): The purpose of learning this course is to

- To acquire the knowledge on the biomass characteristics and biochemical conversion technologies of biomass for energy generation
- To learn thermochemical conversion technologies for converting biomass into energy

Course Outcomes: At the end of this course,

- Possess the knowledge on the biomass characteristics and biochemical conversion technologies of biomass for energy generation
- Know about the thermochemical conversion technologies for converting biomass into energy

Unit I	BIOCHEMICAL CONVERSION	9

Biochemical degradation - factors affecting biogas production - types of biogas plants - construction details - operation and maintenance - utilization of biogas -slurry handling, utilization and enrichment - high rate biomethanation process - landfills - bioethanol - feedstock - process - utilization-- composting - methods Ã¢?? machinery

Unit II	BIOCHEMICAL CONVERSION	9

Biochemical degradation - factors affecting biogas production - types of biogas plants - construction details - operation and maintenance - utilization of biogas -slurry handling, utilization and enrichment - high rate biomethanation process - landfills - bioethanol - feedstock - process - utilization-- composting - methods Ã¢?? machinery

Unit III	THERMO CHEMICAL CONVERSION BY COMBUSTION	9

Thermo chemical degradation. stoichiometric air requirement - Combustion process - chemistry of combustion - combustion zones - emissions. Co firing of biomass. Incinerators - layout. Combustion of wastes and MSW. Wood burning stoves - types- operation

Unit IV	THERMOCHEMICAL CONVERSION BY GASIFICATION AND PYROLYSIS	9

Biomass gasification - chemistry of gasification - types of gasifier - Gas cleaning & conditioning - utilization of producer gas - emissions - commercial gasifiers. Pyrolysis - product recovery - types - biochar - bio oil - operation recovery

Unit V	COGENERATION AND WASTE HEAT RECOVERY	9

Cogeneration technology - cycles - topping - bottoming - problems - applications - waste heat recovery. Carbon cycle- Carbon sequestration-CDM concept-CDM technologies-Carbon emission reduction calculation

BOOK(S):

1. Biodiesel production technology-Sources for biodiesel production-methods-comparative evaluation of different methods

REFERENCE(S):

1. C.Higmen and M.Vander Burgt, Gasification, Elsevier Science, USA, 2003
2. Ashok Pandy, Thallada Baskar, M.Stocker and Rajeev Sukumaran (Editors), Recent advances in Thermochemical conversion of Biomass. Elsevier Publications, 2015
3. A.N. Mathur and N.S. Rathore, Biogas production Management and Utilisation, Himanshu Publications, New Delhi, 1993
4. Robert C Brown, Christian Steven (Editors), Thermochemical Processing of Biomass: Conversion into Fuels, chemical and powder, Wiley Eastern Publishers, 2011
5. K.C. Khandelwal and S.S. Mahdi, Biogas Technology, Tata McGraw Hill Pub. Co. Ltd., New Delhi,1986
6. O.P.Chawla, - Advances in Biogas Technology, ICAR Publication, New Delhi, 1986

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